Commonwealth of Pennsylvania

DEPARTMENT OF AGRICULTURE

Bulletin No. 235

BEEF PRODUCTION

(REPRINT)

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PITTSBURGH, PA.

HARRISBURG:
W. STANLEY RAY, STATE PRINTER,
1917.

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PREFACE

The exceeding high price to which beef has gone within the last two or three years suggests the possibility of profits for the Pennsylvania farmer in beef production.

Our State possesses many features that point to the dairy industry as being specially suited to our conditions, and the progress made within the last decade in the development and improvement of dairy husbandry is very gratifying. This, however, is no indication that the production of beef cattle may not be made profitable if proper methods are employed.

The farmers of our State, as well as those of the "Middle West," can no longer depend upon Western ranches to supply them with cattle to be fed for our export trade and the markets of our Eastern cities.

"Ranching" in some of the Western states is already a thing of the past, and in others, the number of ranch cattle to be found is but a small per cent. of what there were a dozen years ago.

There are large acreages of land in Pennsylvania from which the timber has recently been removed that, if cleared up and seeded with the grass suited to their conditions, would produce great quantiies of nutritious pasture and forage. Such lands, if not reforested, should be turned to the production of livestock, and if catttle of the best beef breeds were placed upon them, the farmers in the southeastern section of the State, who have better conditions for raising corn than can be found anywhere else in the United States, would be able to get their "feeders" without going out of our own State for them, and many thousands of dollars could thus be saved to Pennsylvania farmers.

The author of this bulletin is himself engaged in growing Beef Cattle. This, together with the fact that he is Editor of a Journal that is devoted to General Farming, including Stock Breeding and feeding for market, has kept him in close touch with the leading Agricultural Experiment Stations of the country, so that from personal experience as well as acquaintance with the developments of scientific research, he is able to speak with certainty upon the questions discussed in the following pages.

N. B. CRITCHFIELD,
Secretary of Agriculture.

INTRODUCTION

This bulletin does not pretend to be a complete work on the breeding and finishing of beef cattle, but it aims to present some common sense about cattle breeding and the latest results secured by our experimenters on the subject of economical feeding for maintenance and for market. These last include the results of the winter of 1911-1912 at several experiment stations, and the courtesy of the experimenters who furnished these reports in advance of their publication is gratefully acknowledged. These feeding tests have been quoted feely but are, of course, condensed as much as possible. They are worthy of study because they show how to prepare cattle for market in the most economical way, and in this era of dear feed we cannot afford waste or extravagance in the use of it. Particular attention is called to the experiments showing the use of silage in maintenance and fattening rations. If this bulletin had been published a few years earlier, these important facts could not have been presented. The writer is indebted to Prof. W. A Cochel and Prof Thos. I. Mairs for the proper presentation of this matter. Also to the Illinois, Indiana, Missouri and Pennsylvania Experiment Stations for illustrations.

CHAPTER I

PENNSYLVANIA CATTLE INDUSTRY

The beef cattle industry of Pennsylvania has never been the leading industry of the State nor is it so at the present time. During the period of the beef industry's greatest expansion in this country, when the free pastures of the public lands and the cheap corn of the West gave the cattle raiser of the plains aud the feeder of the corn belt such decided advantages in economy of production, ouly a few sections of the State continued to carry on the busiuess of beef production. The sections which continued to produce beef under stress of Western competition were a few of the eastern and southwestern counties, and even there the business shrank from its old proportions, beef herds being dispersed, vitiated by the use of dairy sires or supplanted by dairy herds. The eastern sections continued to feed cattle because they were devoted to tobacco producing, and relied on the finishing of cattle to provide the manure for that gross-feeding-crop. The southwestern section kept on raising and finishing them because it had rich bluegrass pastures and its people were used to making beef. Local dairy markets were not then so well developed in that section. None of these sections found the business profitable at that time. The dairy business, always a leader in the State's cattle industry, advanced with great strides during this period of Western beef cattle expansion. It had the advantage of rapidly developing markets in this great industrial Commonwealth; of uearby markets; of comparative freedom from Western competition; of a steady income at a time wheu a little cash meant much to the farmer. Aud, moreover, farming conditions and people in Pennsylvania were well adapted to it, with certain exceptions. Some classes of people are better adapted to dairying than others. Wherever the Yankees, the Friends, the Scandinavians, the Germans or their immediate descendants congregate, dairyiug is apt to flourish; but the descendants of the Virginians and early Kentuckians don't like to milk cows. Part of the credit for the preservation of the beef industry in Penusylvania during this trying period must be given to the class of people who were in the cattle business at that time as well as to other conditions.

When the cheap beef from the public lands and the corn belt was flooding Eastern markets, very few sections of the State maintained beef production as their leading industry. And from that time to this it has been a supplementary rather than a leading business in this State. Nevertheless, it is large in the aggregate, and present day conditions are tending steadily to enlarge it. Some of these condi-

tions may be enumerated here because they are vital and their force seems to be increasing rather than diminishing. First, is the fact that Western competition is becoming less severe because the cost of beef-making in the West is steadily advancing with dearer land and higher priced feeds. Second, the Wstern dairy industry is competing more sharply with the Eastern. Third, the scarcity of labor and difficulty of procuring the kind of labor necessary to the arduous and constant work of dairy husbandry. Fourth, the advent of the silo, which tends to reduce the cost of beef production. Fifth, the awakening of our people to the possibilities of their grass lands and the necessity for their improvement. And, finally, the fact that tobacco growing is a renumerative business and requires cattle manure. There are other factors, such as the growing consumption of beef, but they are not operative in Pennsylvania alone. It is not the intention here or elsewhere in this bulletin to compare the dairy and the beef business; but as some kind of cattle will be kept, and as the true conditions should be stated for the benefit of producers, comparison of certain features cannot be avoided. It is probable that dairying will continue most profitable to a large proportion of our cattlemen, but not to all of them, and these are the ones who may possibly benefit from this work. Nor is it the intention of this bulletin to seek to convert dairymen into beef producers.

I have found that he who undertakes to "size up" the beef industry of this State has a big job ahead of him. The industry is so varied and so "scattering" that no exact figures are obtainable, and after all to know the extent of the business is less important than to know how to get the dollar out of it. According to the best information obtainable, there are over 4,000 slaughter and meat markets in the State, 59 wholesale slaughterers are under Federal inspection. There are many smaller slaughtering establishments which, by law, are under State inspection. There were in the State in 1910, 933,055 dairy cattle and 650,515 "other cattle." The reader must be left to estimate the kind of the "other cattle." It is impossible to get at the number of cattle brought into this State to finish for market, the number native to the State finished for market, and the total beef production of the State. Lancaster county handles 50,000 to 75,000 cattle a year. The distilleries of the State handle a great many, and many are brought in by famers to finish. Western markets and West Virginia are the main sources of supply, a great many West Virginia cattle coming to this State. A few Canadian and Michigan feeders are also handled, coming from Buffalo. Many are brought from St. Paul and a few from Detroit. The feeder problem, which is discussed more fully elsewhere, is becoming more acute each year and there is great need of more home-raised feeding cattle.

PENNSYLVANIA'S ADVANTAGES

The primal source of all flesh is grass. A large part of this State is not adapted to the economical raising of grain, but it is adapted to the growth of pasture and meadow grasses. And these lands, as a

rule, are not too high-priced to admit of their use for cattle production. Census reports show that Pennsylvania takes high rank in the per acre production of grass and grain, though the latter cannot, as a rule, be produced so economically as in the West. There is in this State a vast area of land which the plow should not be allowed to touch. It should be in permanent pastures, and these pastures should be stocked with the right kind of cattle, because cattle will grow into money as quickly and as economically as any other stock that can be placed on them.

The water supply of nearly every part of this State is not only adequate but inexpensive. Never-failing springs and ever-flowing streams make unnecessary the water equipments required in many other states.

One of the greatest advantages the cattle raiser of Pennsylvania has, is his numerous markets and their great variety, which makes easy the disposal of any number, kind or quality of cattle. Every town of any size in Pennsylvania is a manaufacturing or mining center. The State's population is cosmopolitan, which means that all classes of meats are readily saleable. Within reach of most cattle producers are markets which will take from one animal to a carload. It is not necessary to have a carload to ship—a single animal can be disposed of at home as readily as any number in most sections of the State. There are regular cattle markets at each end of the State; but so numerous and attractive are the local markets that the great majority of cattle produced in Pennsylvania never get to Pittsburgh or Philadelphia. They are sold to be consumed nearer home. The character of these markets is also favorable to the producer. Most of them prefer animals that are of "handy" weight and in an unfinished condition—not having attained that "ripeness" which costs so much high-priced grain. Here the requirements of the market are in accord with the interests of the producer, because they prefer cattle which he can produce cheapest, without long feeding on high-priced grain. And these handy weight butcher steers—from 900 to 1,200 pounds—sell at relatively higher prices than the heaviest cattle which have cost the producer more. Many Pennsylvania feeders purchase steers in car lots at Western points or in West Virginia, graze and feed them and sell them out to local slaughterers as they are needed.

On account of the broken character of the country, expense for shelter is less than on the wind swept prairies; and with better drainage, dry feed-lots, so essential to the well-doing of cattle, are available at a minimum of expense and trouble. Cattle under four years of age are not taxed in this State.

THE FOUNDATION

The foundation of all profitable animal industry is blood. No matter what branch of animal husbandry is followed the producer who ignores blood builds on an unstable foundation. The foundation of successful beef cattle-raising is beef blood. I say cattle-raising and

not cattle-feeding here, because blood is of vital importance to the man who raises cattle but is not necessarily so to the man who merely buys and finishes them. It is impossible for the cattle-raiser to succeed without the right blood in his cattle, but if the feeder can buy them cheap enough he can afford to feed cattle regardless of their breeding as will appear later. Intelligent feeders, as a rule, are fully aware of the importance of blood and pay a decided premium for it, but they can still make money on ill-bred stuff whenever they can buy it cheap enough; whereas the cattle-raiser cannot prosper with that kind, for he must raise cattle that conform to the requirements of the feeder if he sells to a feeder, or to the requirements of the best markets if he finishes them and sells on the market. The foundation of the beef cattle industry therefore is blood.

FORM AND FUNCTION

What do we mean when we say "blood" in this connection? Let us grasp the idea firmly because it is fundamental. Observation teaches us that the form of an animal when in a state of nature is in harmony with the purpose it fulfills in the economy of nature. Experience teaches us that animals may be developed by selection and environment so that they are especially adapted to a certain purpose. Experience teaches us also that the form of the animals which have been so developed varies according to the purposes for which man breeds them and uses them, just as nature develops forms suitable for her various purposes. Look at the massive draft horse, developed to pull heavy loads on pavements; and the light, fine-boned Thoroughbred or running horse, developed to go a comparatively short distance in the least possible time. Their forms are different because their functions differ and require these entirely different forms. Precisely the same differences exist in cattle, though they are not so clear to the inexperienced eye. It is a fact and not a mere theory that animal form follows animal function. Speaking of a class of animals it is evident that the form will be modified or shaped according to the function. When a group or class of animals has been bred for generations to fulfill a certain purpose and the individuals which constitute that class acquire the form best adapted thereto it becomes a fixed characteristic, they are able to transmit it and do transmit it. This power to impress on descendants these characteristics is called prepotency, and an animal is prepotent as we use the term in proportion to its ability to transmit the desired characteristics. Prepotency is usually the result of pure breeding for a certain purpose for generations; at least this is the only source to which we may turn in confidence to secure prepotency, for the purpose of improvement. Use of this prepotency, through animals of breeds which have been bred for the purpose of beef improvement, is what we mean when we talk of using beef blood. Use of animals which belong to a breed with beef characteristics, are good beef cattle themeselves, are descended from generations of good beef cattle and promise to transmit the qualities

Fig. 1. SHORTHORN.

Fig. 2. JERSEY.

THE DIFFERENCE IN TYPES.

These photographs show the difference between beef and dairy types. Both animals are in show condition, both prize-winners at State Fairs in the same year. The Jersey has a good butter record; the Shorthorn a good record in the shows. An illustration of the relation of form to function.

they have inherited and possess. All this is elementary of course; yet how many there are who fail to heed it, and fail to succeed in producing what would make them a profit because they violate this fundamental principle.

Two illustrations showing the effect of breeding for different purposes on the bovine form are given herewith. (See Figs. 1 and 2.) Both are reproduced from photographs taken at leading shows in the same year. Both animals are young, both prize-winners and both in show condition, a high state of physical development. One is a Jersey, a representative of a breed which has been bred for generations to convert its feed into milk rich in fat. The other is a Shorthorn, a representative of a breed and a strain of it which has been developed to convert its feed into meat. The effect of this attempt to secure one thing in case of the Jersey and another thing in the case of the Shorthorn is evident in the forms of the animals and calls for little further comment. Is it not clear that a man should get beef blood if he expects to produce beef cattle?

Beef breeds of cattle owe their present form to two things—the rquirements of the slaughterer and the requirements of the producer. The slaughterer cares nothing about the beef animal except the amount and the quality of the meat he can cut out of it. He can get most high-priced meats, with least cheap meats and least waste, out of a blocky, thick-fleshed, strong-loined, fine-boned, neat-headed, short-legged animal, consequently he pays most for this kind. His money talks for animals of this kind in no uncertain way, and this is why breeders of beef animals heed what it says. But extreme beef form may be to some degree incompatible with profitable production, and the requirements of the producer have kept us from going too far, losing perhaps fecundity or milk and getting too fine a bone or too small frame, which means an animal that will not make pounds enough. Beef cattle of the highest type today conform very closely to the ideal of the slaughterer and suit the producer also.

BEEF BLOOD

Where may we look for the blood that produces at a profit the kind of cattle that the market requires? Where may we find the animals that transmit to their progeny correct beef form? Obviously among the beef breeds, which for generations have been selected, bred and fed for the purpose of making the most and best beef at the least cost to the producer . There is no other source of beef excellence, though all cattle will produce beef of some kind, in some quantity and at some price. Now and then we hear of how good a Jersey steer's meat is; of how fast a Holstein has gained; or how fine Old Brindle's calves used to be. But the man who has to make his living out of meat bought in the animal or "on the hoof" and sold on the block never pays very big money for Jersey, Holstein or old-fashioned native cattle. He is not buying from sentiment or prejudice, he would pay premiums for any of the above if he could get a return to correspond. But he knows from experience that the most economical yielders of

beef, and the producers of the best beef, are not found there but are found in the beef breeds. He has learned this lesson so clearly that he discriminates sharply against other than beef breeds; but many producers have not learned it so well. When in this country did dairy-bred cattle or their grades win a prize in competition with beef breeds at a beef show? What markets have they topped? What cattle raiser has made money growing and finishing them? Or, if by some accident, any man has done this, how much better he might have done with the right kind!

CHAPTER II

THE BEEF BREEDS

Let us now look at the breeds which are recognized as beef-producers, and study them and their characteristics, though not at great length. All have their place in the production of beef on the farms of this country. Each breed has superior and inferior individuals and types in it. All breeders are not true breeders, and by carelessness, neglect or ignorance, scanty rations, unfavorable environment, etc., some breeders have perpetuated cattle which are not true representatives of their breed. It behooves the man who wants to invest in beef cattle to learn to distinguish between true-type and so-called beef cattle. This the following descriptions and photographs are intended to help learn to do. And that the descriptions given are inadequate because space limits must be observed, is fully realized. A volume might be devoted to each breed, indeed many volumes have been written about every first-class breed of cattle, and more will be.

BEEF PRODUCERS

The breeds which claim attention as beef producers are: The Shorthorn, and its branch, the Polled Durham, the Aberdeen Angus, the Hereford and the Galloway. Other breeds which claim beef as one of their characteristics are the Red Poll and the Devon, of which more later. The Highland, Sussex, Welsh and Longhorn breeds need not be discussed, as none of them is within reach of Pennsylvania cattle raisers, and probably none of them is so desirable that any one should go to the trouble and expense necessary to get them. All beef cattle requirements, whether of producer or market, in Pennsylvania, can be met by the use of Shorthorns, Polled Durhams, Angus, Herefords and Galloways. The Brown Swiss breed has not been mentioned as a beef-producing breed because its tendency in recent years has been in the opposite direction. Like the Holstein breeders, Brown Swiss breeders have relinquished their claims to beef, but they can claim with excellent reason the production of high class veals. Here in Pennsylvania has been developed a breed of cattle like no other in this country, white and hornless, called the Polled Albion. The breed is not numerous as yet, is not valuable for beef production

and not likely to become highly popular for any purpose. It would afford an excellent subject for experimentation, however, by some constructive cattle breeder, who, by the judicious use of White Polled Durham or Shorthorn bulls and close selection, might develop it into a highly useful as well as a novel breed. This suggestion is for the man who has time, money and taste for such things. The cattleman who must live by his business will let all fads and freaks alone.

ESSENTIALS OF A BEEF ANIMAL

The essential points of a good beef animal are the same in all breeds, so before describing the breeds in detail let us consider them. A correctly formed beef animal in good beef condition is, in general appearance, deep in body, with top and lower body lines almost parallel; "square built," meaning broad when viewed from the side, from above or from either end; in general appearance pleasing to the eye, without angles or lumps at any point; symmetrical and clean cut. The head should be broad at forehead and between eyes, nose straight and rather short, muzzle broad, mouth and nostrils large, jaw wide and strong, eyes prominent and placid; ears well set and not too large. A long, narrow, cramped head, with badly set, small eyes, is usually indicative of a poor feeder or a bad disposition. A long, heavy nose is thought by some to denote milking qualities, but it probably means nothing but a coarse head and bony structure. The neck should be rather short, broad on top, clean cut at the throttle, tapering from body to head, top almost level with the back (except on bulls, which should have crest), and full at the "neck-vein" or point of junction with the body . A long, slim neck is decidedly objectionable in a beef animal because the neck is cheap meat, and a long neck usually goes with a "rangy" animal, a short neck indicating a blocky one. The shoulders should be well covered with flesh, laid neatly with blades close to body, not prominent at point. A coarse shoulder makes the animal appear weak at heart-girth. A smooth, well-covered, well-laid shoulder is one of the most difficult points to secure in a beef animal if the animal has proper "breadth of beam." The chest should be deep and broad, with a good development of breast. Brisket broad, setting legs well apart. A narrow chest is supposed to indicate lack of constitution, but it really indicates a lack of breadth in the animal, which is objectionable. Dairy cattle have very narrow chests and are not deficient in constitution either.

The back of a beef animal is its most important part, for on it and its connections are the highest priced beef. It should be broad all along, level, well covered with flesh. The ribs must be well sprung and the hips well set apart (but covered) to make such a back, and the animal must be "close-ribbed"—not much space between last rib and hook bones. These bones should not be prominent or too close together. Such a back will cut a large proportion of roasts and

steaks, the most valuable parts of the carcass. The ribs should not be too long and straight, making a flat body. The flank should be well let down. The rump should be level and full, not falling away sharply from the hooks to tail, or sloping off abruptly from the back. The hind quarter should appear broad from the side and thick when viewed from rear; well fleshed down toward the hock. The tail should be set on a level, not raised above line of back or drooping below it. The legs should be set squarely under the animal; should be straight and not "proppy" in front; not too crooked or hooked-in behind. Bone to correspond with the size and weight of animal; as fine as is consistent with weight carrying. Legs short; usually made so by short shanks. Shank bones short. Hair and hide indicate thrift and feeding quality. Hide should be loose and of medium thickness. The hair should be abundant, rather soft to the touch, not coarse or wiry. The kind of hair on a fat animal is believed to indicate the kind of meat beneath it; but probably all experts will be fooled in this. The flesh should be smoothly laid on the carcass, not "lumpy" to excess. The carriage should be graceful, the animal moving easily, indicating a well-balanced mechanism.

But after all this there is much lacking in this brief description of a beef type. It would still be lacking if space were unlimited, for it is something that cannot be told. It is that indescribable symmetry, character, quality or combination of good things that appeals to the eye at once and cannot be dissected or described. The observer will know it when he sees it—but he can hardly tell what it is or how he knows it. These are the general characteristics of beef cattle briefly outlined.

DUAL-PURPOSE CATTLE.

I have never known this subject to be brought up, in the agricultural press, at a meeting of stockmen or "around the stove" without a controversy. Probably this is because we have no generally accepted definition of a dual-purpose animal, and without well-defined premises it is impossible to reach a definite conclusion. Men's ideas as to what constitute a dual-purpose animal vary widely. The usual definition of a dual-purpose cow is one that will be profitable as a dairy animal, and when bred to a bull of beef blood produces a steer that will be a satisfactory beef animal.

This definition is lame in several vital points. Under it a dual-purpose cow could come from almost any breed. A few years ago one steer in a carload from the Ohio Experiment Station that topped the Pittsburgh market was out of a pure-bred Jersey cow. In another case a steer that sold along with and at the same price as a load of champion steers at a fat stock show was out of a Jersey cow.

Both steers were the get of pure-bred Angus bulls. Yet these Jersey cows, which could be classed as dual-purpose cattle under the above definition, are examples of special-purpose breeding. Seldom are sires so prepotent or cows so susceptible as in these cases. This definition is vitally defective also in that it provides no means of perpetuating the dual-purpose type if it really defines it. "When bred to beef bulls" is fatal to the idea of perpetuating the type if it is to be a "profitable dairy" type.

Another definition is that the dual-purpose cow should be a medium between dairy and beef types, with more milk than beef-bred cow and a better beef form than the dairy-bred cow. This is also a vague definition, and here again we run against the trouble in all such breeding—the difficulty of perpetuating a type of cattle that will be profitable for two distinct purposes, which purposes involve different physical structures, and what is no less important, different mental characteristics or temperaments.

There can be no dispute as to the attractiveness of this ideal of dual-purpose cattle; yet how to get and perpetuate cattle that will be profitable dairy animals and profitable beef animals is a problem unsolved. Several Experiment Stations have given us good records at the pail by Shorthorn cows, but these cows are all of a more or less pronounced dairy type; and it is asserted that "when bred to beef-bred bulls" they would produce good steers. But when so bred they would not produce as good dairy animals as themselves, and so the man who breeds them is facing failure at one end or the other of his dual purpose scheme.

The breeders of the so-called dual breeds have not succeeded in producing a class of animals with creditable records for both purposes. Some individuals may have been produced but no class that "will fill the bill." Some breeders place dairy qualities first and their cattle approach the dairy type. Others put beef first and their animals gravitate toward the beef type. While the scale of points may give equal prominence to dairy and beef qualities, it will be found that breeders are rare who do not deviate one way or the other according to their locality or their interest. As a rule, heretofore Eastern breeders have leaned toward dairy qualities and Western breeders toward beef, and the result is seen in the lack of uniformity of type whenever the two sections meet in the show ring. The judge of a big ring of Red Polls or Devons has abundant reason for perplexity. He never finds uniformity of type unless all the cattle come from one section or one herd.

This leads to a decided difficulty in breeding pure-bred dual-cattle—that of getting blood to perpetuate the breed that does not take the herd out of line. All breeders will acknowledge that they have trouble in "keeping in the middle of the road." Their cattle show it too. Another drawback to the breeding of pure-bred dual cattle is the limited demand for the bulls. When a man has a herd of cattle he

usually wants to breed it either for more milk or more beef; and he is not going to resort to bulls bred for supremacy in neither line to attain his object. He wants a bull strongly prepotent in one direction or the other, which real dual cattle cannot be if they have been bred according to rule.

It is a fact that nearly all men who have herds of dual-purpose cattle in the East place greater emphasis on the dairy than on the beef value of their stock. Milk records of Red Polls or dairy Shorthorns are seen much more frequently than records of their beef production. Demonstrations of their merits at the pail are more frequent and more emphatic than are demonstrations of their value as beef producers. Weights of beef animals are sometimes given, but weight is no criterion of beef excellence. Holsteins can make weight, but as beef animals they are a failure. It is a rule, to which I know no exceptions, that when a cattle breeder turns his attention to milk production to the extent of keeping milk records and breeding cattle that will make good milk records, he soon has dairy cattle —he loses beef qualities just in proportion as he gains milk. No matter what the breed name is or what he calls them, he has dairy cattle. Most of the Eastern breeders of dual-purpose cattle have followed this course, and their cattle are now nearer dairy cattle than beef cattle. Standards have not been adhered to because milk has been more profitable than beef and they have naturally bred for it. A heavy and persistent milking race of cattle will lose their beef form in time. We are told that beef form and large and persistent milking qualities are not physically incompatible. We are also told that there is no physiological reason why a hen cannot lay two eggs a day. Nevertheless the hen does not do it, nor does the cow so shape herself that she reaches high excellence in both directions. To what we consider true dual-cattle the above does not apply—they are fair for both beef and milk, and only fair as compared with beef breeds on one side and dairy breeds on the other side.

BEEF COWS AS MILKERS

There is no error more persistently or more widely circulated than that which relates to the milking qualities of pure-bred beef cattle. Institute lecturers and writers for agricultural papers have persistently discussed the beef breeds from the standpoint of ignorance. Assertions that cows of these breeds would not raise their own calves, that they put everything on their backs and nothing in the pail, are so frequently heard as to nauseate the man who has had experience with these cattle. Probably observation of show females, which have been dried up and their calves fed by nurse cows with

the express intention of fitting them, has led to this impression. Perhaps it has been passed along thoughtlessly from one man to another and so perpetuated. The late John H. Wallace, founder of the American Trotting Register, told me that when he was preparing a certain work on the horse he spent a long time in England delving into horse literature. He found that most of the ideas about horses then in print were simply repetitions. The authors of works about horses had just gone along copying from each other from generation to generation. And this may be the reason for the perpetuation of the milkless beef cattle idea. A little reflection reveals the fallacy of this idea. The breeder of pure-bred beef cattle gets one product from his females—calves. If a cow will not raise her own calf and raise it well to six months or over she is a money loser for her owner, and he has every reason to discard her, unless in some exceptional case when a high reputation as a show animal or as a breeder or a fancy pedigree might save her. It takes milk to raise a big beef-bred calf, and when we see a pure-bred beef cow with a husky calf at side we know she is giving milk and a good deal of it. She does not give it in such quantities or for so long a period as the dairy cow, but she gives a good deal of it and it is usually rich. If she milked as heavily and as persistently as high-class dairy cows she would, regardless of her breed, become a real dairy cow in the course of generations, look like one and produce beef like one.

In view of the above facts I believe that the best "dual-purpose" cow for the man who aims to produce beef is a beef breed. Breed cattle for beef, handle them for milk, and the dual-purpose cow that is best suited to the beef producer is found. She will not be a profitable dairy cow as compared with the dairy or even the dual breeds as bred in the East; but the beef producer should not want her to be. Herefords, Angus and Shorthorn cattle have been used in this way with satisfaction in Great Britain and in this country. Herefords have even won a prize in dairy competition and Angus have been used to produce cream right here in Pennsylvania, showing the result of management for milk. In all such cases the dairy product is a by-product, and should be so regarded. Herefords and Angus, Galloways and most Shorthorns are beef cattle and their dairy products are a side-issue. But if one must have a dual-purpose animal and beef is his main object let him pursue the above course. He will get the beef anyhow and the rest he will get according to his management. Inasmuch as our Eastern herds of dual-purpose cattle are bred mainly for dairy use, they are not, as a rule, to be recommended to the beef producer. Nor are all members of the beef breeds to be recommended to the man who wants to make beef. Some Shorthorn herds have been so developed that they are really dairy cattle. One such herd in Pennsylvania, now dispersed, had excellent records at the creamery (around 325 lbs. average for herd a year), but it did not take an ex-

pert to see that they were no longer meritorious beef cattle. The bulls of such blood should not be used in herds that are expected to produce beef.

It is probable, notwithstanding all the difficulties of the situation, that much of the beef raised in Pennsylvania will come from cattle that are used to supply milk and also to make beef; and their breeding must depend on the relative importance of the two products in the breeder's mind. If he is a dairyman first and a beef-producer afterwards the dual breeds may be satisfactory. If the reverse is true they are not to be recommended as now bred. And further, it is probable that the man who is in the dairy business should not attempt to combine dairying and beef raising as some have done. It will pay him better to run his dairy machine to full capacity than to operate two machines at half capacity.

In all the above it should be remembered that breeds as a class and not individuals are discussed. There are a few milkless cows in the beef breeds, a few good steer producers in the dual breeds, a few trotters that can't trot fast enough to keep warm and thoroughbreds that can't run any faster in their respective breeds. But when we want a horse to trot we go to trotting blood, and this rule holds good all along.

Now let us look at the history of the breeds used by beef-makers and at the classification of all breeds in this country.

CLASSIFICATION

Our domestic cattle are kept for three distinct purposes—work, beef and milk. These functions are none the less distinct because two and sometimes all three are combined in the same individual. The work ox is no longer important and may be ignored in classification of the breeds as already stated. The breeds that are used for the production of animals primarily for beef are known as the "beef breeds." Those breeds which are used almost exclusively for the production of dairy cows are known as the "dairy breeds." Those

breeds in which an attempt is made to combine the qualities of meat and milk production are known as "dual purpose breeds." The following outline gives the generally accepted classification:

Beef Breeds:

Shorthorn (Polled Durham),
Hereford,
Aberdeen-Angus,
Galloway.

Dairy Breeds:

Jersey,
Holstein-Friesian,
Ayrshire,
Guernsey,
Brown Swiss,
Dutch Belted.

Dual-Purpose Breeds:

Milking Shorthorn,
Red Polled,
Devon.

In the above outline an attempt is made to give the breeds of each class in the order of numerical importance in this country as indicated by the herd book of registrations.

SHORTHORN

The Shorthorn (see Figs. 3 and 4), is by far the most numerous and is generally regarded as the largest breed of beef cattle in this country. This breed had its origin in the valley of the river Tees in northeastern England, in the counties of Durham and York. On this account its ancestors are known as Teeswater cattle. While the name Durham has been applied to the breed indicating in part its origin, the official name is Shorthorn except in the hornless sub-breed known as Polled Durham. In color, Shorthorns may be pure red, pure white, or any combination of the two, roan or spotted. Roan is the characteristic Shorthorn color, in fact, all roan cattle owe their color to Shorthorn blood. Charles and Robert Colling, who began breeding about 1780, are generally regarded as the first improvers of the breed. They were followed by Thomas Bates and Richard Booth and his two sons, Thomas and John. Amos Cruikshank of Aberdeenshire, Scotland, is the originator of the Scotch type of Shorthorn, which has for many years been the most popular in the country for beef production. Bates and Booth stock was used as a foundation

Fig. 3. A PENNSYLVANIA SHORTHORN BULL.
A good type in ordinary condition.

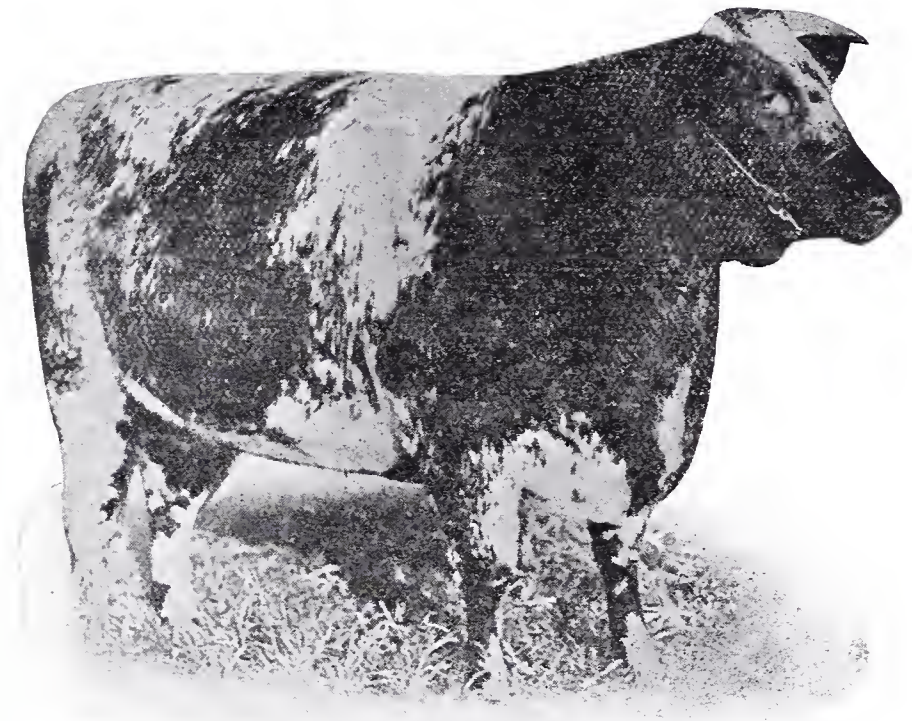

Fig. 4. A CHAMPION SHORTHORN COW.

Fig. 5. A PRIZE-WINNING HEREFORD BULL.
A champion at Western shows.

Fig. 6. CHAMPION HEREFORD HEIFER.
Grand champion in Western shows in 1910-11.

stock by Mr. Cruikshank in forming his Scotch type. The Bates Shorthorns were large, clean cut animals, with neat trim head and neck, fine bone, smooth, sleek coats and good milkers, and their blood predominates in our herds of milking Shorthorns. The Booth Shorthorns were equally large but somewhat coarser. They were generally more meaty animals than the Bates stock, with heavier hind quarters. The Scotch Shorthorns are blockier than either of the other types, have shorter legs, bigger middles, a heavier coat of hair, fatten more readily and are not so good milk producers.

As already stated the Shorthorn has been our most popular beef breed. This is partly owing to its power of adapting itself to its surroundings and partly to its wide variations in type and color. This variation is so great that Shorthorns may be had to suit most any taste. When it is desired to produce cross bred animals for meat the Shorthorns mate well with any of the other beef breeds. The Secretary of the Shorthorn Breeders' Association is John W. Grove, Union Stock Yards, Chicago, Illinois.

The Polled Durham is merely a hornless sub-breed or variety of Shorthorn. Double Standard Polled Durhams are pure bred Polled Shorthorns. Single Standard Polled Durhams have a trace of the blood of common stock. They originated in this country within the last half century, and have all the characters of the other Shorthorns except the horns.

HEREFORD (See Figs. 5 and 6)

This is a breed of large red cattle with white faces, originating in the county or shire of Hereford in the eastern part of England. They are low down, blocky animals with broad backs, short necks and prominent briskets. The face is broad and the horns of the males inclined to be spreading. The coat is inclined to be curley. This breed conforms strictly to the beef type and no claims are made for it in milk production. It is pre-eminently a grazing breed, the animals fattening readily on grass without grains. No other breed has been so popular on grazing lands west of the Mississippi. Herefords are more uniform in type than the Shorthorns, because they have been bred for only one purpose. They are favorites with feeders, particularly for a short feeding period, and with graziers. Their chief fault is lumpiness or unevenness in laying on fat. The improvement of the Hereford cattle began rather earlier than that of the Shorthorns but did not make great progress until after the middle of the nineteenth century. Their introduction into this country, where they have competed with the Shorthorns, has doubtless resulted in greater improvement in both breeds than either would have made alone. Benjamin Tompkins is considered the first improver of the breed, followed later

by John Price and John Hewer. The Hereford of to-day, however, is much superior to what it was when these men left it, particularly in the hind quarter. The American Hereford Cattle Breeders' Associations, during the past five years has registered about 28,000 pure bred animals annually. R. J. Kinzer, Kansas City, Missouri, is secretary of the association.

ABERDEEN-ANGUS

This breed is also known as the Polled Angus or simply as the Angus. It is a black breed of hornless cattle from the northeastern part of Scotland, chiefly from the counties of Aberdeen, Kincardine and Forfar, the latter two constituting what was once known as Angus. (See Fig. 7.) The animals of this breed are compact, low down and smooth in outline. The body is more cylindrical than that of the Shorthorn or Hereford. The neck is short and the head neat, with a prominent poll. Angus are hardy, good breeders and grazers, and mature early. They are favorities with butchers and packers because they dress high percentages of beef and cut with little waste. In proportion to numbers Angus produce more high priced steers than any other breed. The improvement of this breed began later than that of the Shorthorn and Hereford. It was not until 1808 that Hugh Watson, who is regarded as the first systematic improver of the breed, began his work. He was followed by William McCombie and later by Sir G. M. Grant, and others. The American Aberdeen-Angus Breeders' Association has registered about 12,000 animals per year since 1906. Charles Gray, 817 Exchange Avenue, Chicago, is secretary. This breed has gained very rapidly in favor among beef-makers in the past ten years.

GALLOWAYS

This is also a black polled breed from Scotland, but comes from the southwestern part, from the counties of Ayr, Dumfries, and Wigton. Galloways are not so numerous as the breeds already described. They may be distinguished from the Aberdeen-Angus by their greater length of body, more rectangular form, longer wavy coat, broader forehead with less prominent poll and heavier bone. They are very hardy, stand rough treatment and exposure well. The government has introduced a few small herds into Alaska to test their adaptability to that climate, and is developing their milking qualities. The quality of the meat is of the best. There is considerable demand for the skins for robes, coats, etc., as they have more abundant and longer hair than the other breeds. While black is the only color permissible, a tinge of brown is not objectionable. R. E. Brown, Pedigree Record Building, Chicago, Illinois, is secretary of the American Galloway Breeders' Association.

Fig. 7. AN ABERDEEN-ANGUS HEIFER.
A winner at leading Western shows.

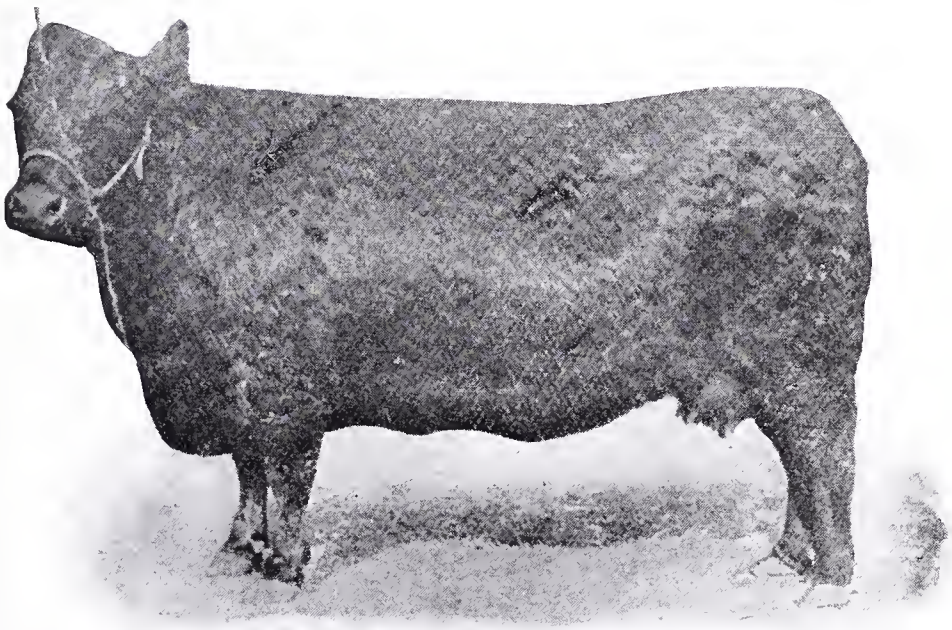

Fig. 8. A CHAMPION GALLOWAY COW.

Fig. 9. MILKING SHORTHORNS—TYPE OF BULL.

Fig. 10. MILKING SHORTHORNS—TYPE OF COW.

MINOR BEEF BREEDS

The Longhorn, once prominent in England and still bred there to some extent, is not bred in this country.

The Sussex has been imported and bred to a limited extent but has not gained any popularity outside of comparatively narrow area.

The West Highland breed has been introduced but chiefly by wealthy men who keep them more as novelties than for any useful purpose. They are slower to mature than the other beef breeds, dun to brown in color with wide spreading horns, and long shaggy coats. They are said to produce the best quality of meat and are useful in their native home, the west coast of Scotland and the neighboring islands, but have no place on American farms.

THE DUAL-PURPOSE BREEDS

These breeds are claimed to combine the meat production qualities of the beef breeds with the milking qualities of the dairy breeds. Such animals have been much sought after by the common farmers in some sections but have received little attention from our American breeders. It is so much easier to breed for one set of characters at a time than for two.

DAIRY SHORTHORN (See Figs. 9 and 10)

This is not a distinct breed but is a term used to designate certain individuals and strains of the Shorthorns. They are quite common in England but have received little attention in this country for the last thirty years. The popularity of the Scotch type to compete with the purely beef breeds, and the introduction and promotion of the dairy breeds have been against them. There seems to be at present some revival of interest in these cattle, due largely to their milk records.

RED POLLED (See Fig. 11)

This breed of cattle whose name is so descriptive of its most apparent distinguishing characters, comes from the countries of Norfolk and Suffolk in the southeastern part of England. The breed as a whole probably comes nearer than any other to the dual-purpose ideal. Breeders, however, will unconsciously lean toward either the beef or dairy characters so that there is wide variation. This breed has produced some excellent dairy cows and some good beef animals, but does not produce exceptional merit in either direction.

DEVONS (See Fig. 12)

This is one of our oldest breeds and at one time was very popular in this country, but has declined because of its slow growth and lack of size. Devons are solid red in color with comparatively long horns. They are smaller than any of the present beef breeds and mature more slowly. Their home is in southwestern England, in Devon and Somerset. They vary more widely than the Red Polled. They are not bred much except where oxen are in use, and they make the best and "handiest" oxen known. There is a demand for the steers in some sections for this purpose, and the hardiness of the cattle also commends them to some localities.

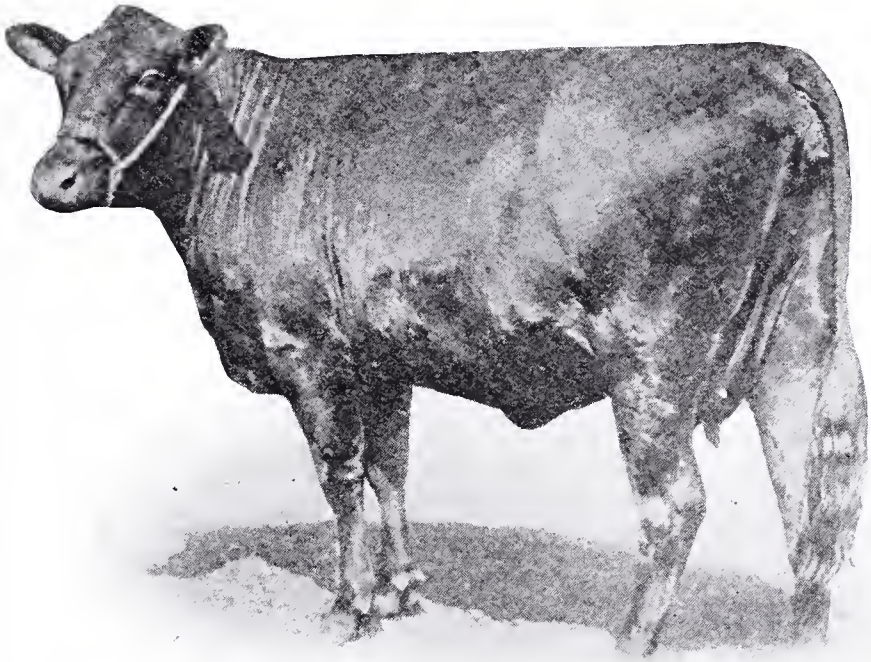

Fig. 11. A MODERN RED POLL TYPE.

Red Polls are the leading Dual Purpose Breed in this country, if we call the Shorthorns Beef Cattle.

Fig. 12. A CHAMPION DEVON COW.

This breed is not kept in large numbers in Pennsylvania now. This cow was imported and a champion at shows in this country.

CHAPTER III

GROWING BEEF

The late L. H. Kerrick, of Illinois, said, "I do not feed cattle, I grow beef." On land worth perhaps $200 an acre he continued to raise his own steers when most farmers had abandoned the raising of cattle and had become feeders only. The question for every man to solve is whether it will pay him to "grow beef," whether he can make more money by raising his cattle or by buying them and finishing them. The cost of a calf raised on high-priced land and costly feeds such as we have in Pennsylvania may be too great in comparison with the cost of a feeding steer bought on the open market to allow a farmer to consider the growing of cattle at all. But let me say here that while counting the cost of any product is good business policy, the figures are not always reliable when applied to beef cattle. Probably there is not at present a farming state in the Union where, figuring everything—investment in land, prices of feeds, interest and depreciation on cattle, taxes, equipment, labor, etc.—it can be shown that it pays to raise a steer and finish him for market. Yet many people are doing it and not getting any poorer either. In fact they seem to be somewhat better off than men who figure that it can't be done, who don't do it, and consequently have no steers to sell. The fact that cattle grow into money without utilizing marketable products for every pound of growth must be considered; and this will always render more or less indefinite all calculations as to the cost of raising a steer on the farm.

A bulletin issued in 1898 by the Minnesota Experiment Station records an experiment made by Prof. Thomas Shaw to find out "whether beef could be grown at a profit * * * on an arable farm in which considerable money had been invested." The steers were taken at birth in the fall, and marketed the January after they were two years old. Let us take the best steer and see how he would figure out. According to this experiment he showed a profit of $20.95 with-

out allowance for risk, for interest on money invested in steer, feed or "plant," and without counting cost of grinding grain or allowing anything for labor. It looks pretty good until we come to examine the prices of the feed which it took to make this steer weigh 1392 lbs. as a long two-year-old. Shaw's feeds were valued thus: New milk 63c. per 100 lbs., skim milk 12c. per 100 lbs., wheat bran $6.50 per ton, oats 14c. bu., corn 18c. bu., barley 16c. bu, oilcake $14.00 per ton, clover hay $3.50 per ton, green feed 75c. ton, mangels 4½c. bu., corn silage $1.25 ton. The steer sold for $4.75 cwt. These figures seem rather strange to the Pennsylvania farmer of 1912, and yet they were the farm prices in Minnesota in 1898.

Apply present prices where would this steer finish as to cost? He would be a money loser even on a high cattle market. With whole milk, bran, corn and oats at a cent a pound, clover hay $10.00 a ton and corn silage and mangels $2.00 a ton, allowing $1.00 a month for pasture, he would cost nearly $85 for feed alone, and that feed much lower than the average of Pennsylvania prices in recent years. This is a charge against the steer for feed only of over 6c. a pound, and a cattle-raiser can soon figure himself into the poorhouse by adding the cost of the calf at birth and the other charges. Nevertheless cattle raisers do not seem to be overcrowding our poorhouses as they would do if the figures which represent cost of production told the whole story. Cattle feeders who figure on the same basis seldom show a large profit, nor do experiment station cattle generally show profits that would attract men to the business of feeding. Yet judicious and persistent feeders of cattle have found their farms and themselves richer for their work. It must be admitted that years of actual loss occur; yet losses cannot be so heavy as some figures show and profits must be greater or our beef-makers would be a class of bankrupts. The cost of raising cattle will be discussed a little farther on. But it may be said here that it is not so great as some experiments and tests would indicate. Most of these assume that everything a calf eats is marketable at a given price; but the fact is that these things are not all marketable and if they were the cost of marketing them would exceed their value. The busy farmer can find time to market only a few things, and he must either allow much to be wasted or turn it into animal products against which it is not fair to charge values that could not have been realized in any other way. The farmers of Indiana evidently understand these things, for they report the cost of a calf at 5 months of age (weaning time) to be $12.82, at one year old $20.62 and at two years old $32.76. These reports were made during a period (1907) of high prices of all feeds, and while they do not include all things are evidently more nearly correct than some of those which attempt to figure in too many things.

PURE BRED CATTLE FOR GROWING BEEF

The man who expects to grow beef in this State will do well to consider the advantages of a herd of pure-bred cattle. High grades of any of the beef breeds will no doubt give satisfaction, if the policy of keeping pure-bred bulls is adhered to, but there are decided advantages in the pure-bred herd for the true cattleman, and none other should attempt to raise them. One of the greatest advantages incident to a pure herd is the outlet for heifers as breeding stock instead of butcher stuff. The power to regulate sex in animal breeding has been wisely withheld from us, and the large proportion of heifers that must be disposed of has been a serious drawback to the grower of beef who has grade animals. Heifers are discriminated against by our slaughterers to a greater extent than seems right, and to a far greater extent than in Great Britain. The beef breeder with pure-bred heifers can usually find an outlet for them for breeding purposes at more than steer values.

Another advantage of a pure-bred herd for beef-growing is the ability to dispose of an occasional bull calf as a breeding animal at a price that is better than could be realized by keeping him a much longer time as a steer. As long as breeding is not an exact science there is a possibility of an outstanding good calf from a pure-bred herd that may be worth more than beef value to some one for exhibition purposes either as a bull or as a steer. Pure-bred steer calves seem to be in demand for this purpose, and command good figures at the present time if suitable for it. The third advantage of a pure-bred herd is the superior average quality and greater uniformity of the cattle that come from it. A pure-bred herd will produce good cattle more uniformly than a grade herd—there is less chance of reversion to some undesirable ancestor. There are a few disadvantages to this plan also. The first and greatest is the original investment. Probably a herd of pure-bred cows adapted to the production of good beef cattle will cost about twice what a good grade herd would cost. It may be secured sometimes for only a slight advance over the cost of grades, but the average may be as just stated. A pure-bred herd will also require more attention as to means of identification, registration, etc., but this is not more than any good cattleman ought to give anyhow; and the cost of registration should be made up in the selling price. Age limits as to registeration are sufficiently liberal to prevent unnecessary expense in this particular.

If there are any vital disadvantages in a pure-bred herd they are not known to the writer. As a rule it is better to start with fewer cattle and pure breeding than to start with grades. The increase will soon build up the herd, and the original investment may be kept within

proper bounds by the smaller number of cattle, taking advantage of sacrifice sales by other breeders, who, through misfortune or age, are compelled to retire from the business, or in a period of discouragement lose interest in it. There have been ample opportunities in recent years for Pennsylvanians to secure these bargains—a fact which does not appear to speak favorably for the business. But men who are willing to take hold of a sound business at a time of depression find their reward usually, for they hit the period of reaction which invariably follows a great depression. And this suggests the necessity of sticking to whatever business man, farm and markets suit. A couple of years ago a Pennsylvania breeder sacrificed a good herd of beef cattle for the sake of going into the sheep business. Cattle were low and sheep were high. Since then the positions of the two have been reversed. If the beef cattle business is unpromising, stay out of it; but if convinced that it is suited to the man, the farm and the markets stay with it during good and bad times. The constant shifter is likely to hit the low spots all around, and he can never breed stock of as good quality as can be produced by the man who "sticks to his bush."

Probably the number of men who will make a business of growing beef in Pennsylvania will remain comparatively small; but the subject must not be neglected on that account. Fewer men everywhere are raising cattle and more are depending on somebody else for feeders. The only possible result of this policy is that feeding cattle will sell too high, as they often do now, to make feeding a safe business when grain is dear and beef markets uncertain to balance proportionately because of the competition of other meats. This will sooner or later make the production of beef cattle and the growing of beef a necessary if not a much more profitable business. The ranges are becoming farms, and the farm lands of the corn belt are becoming too high-priced to allow of cattle raising. This situation means a constantly enlarging need of feeding steers, which must be grown on a constantly decreasing area of cheap land in the West. Besides the range territory which formerly furnished many feeders is going to send to market more beef and less feeder stuff hereafter. Hay fed cattle have sold remarkably well of late years, and a new territory has been added to that devoted to the finishing of beef cattle and subtracted from that formerly supplying feeder material. Unless the markets of this country are thrown open to Canadian and Mexican cattle it will be necessary for this country to raise more cattle on its farms; and the territory which produces grass on land not too high in price will develop this industry most. Such a territory is a good deal of Pennsylvania.

THE TWO PLANS

Two plans are open to the man who expects to grow beef in this State: First, the making of "baby beef;" and, second, the slower method which puts the cattle to market as long two-year-olds or short three-year-olds. The plan to be followed depends on the price of land, the relative proportion of pasture and grain land, and the cost of pasture and grain. To produce "baby beef" requires a longer period of grain feeding than to make two-year-old steers ready for the block. On the other hand the younger animal shows more gain for the quantity of feed consumed and the maintenance charge against him is reduced just as much as he beats the older one to market. Some beef growers will find it more profitable to push their calves right on to market and others to grow them on cheap grass and roughage until past two years old then fatten on or just after grass with a comparatively small outlay for grain. The man who keeps a herd of pure-bred cattle to grow beef will usually prefer to push his calves to the block at an early age, and he can usually do so at reasonable cost and still have them fat enough to suit the better butcher trade of this State. We shall first take up the growing of beef from the standpoint of baby beef, and in order to do so we must begin at the beginning of the whole beef business—the fundamentals of beef cattle management, feeding, and marketing.

In selecting a breed with which to procure baby beef, Herefords, Angus, Galloways, Shorthorns and Polled Durhams are available to Pennsylvania breeders. The first three are well adapted to it, as a rule, because they are of an early-maturing type; but not all Shorthorns are suitable for the production of baby beef. If Shorthorns are chosen, the quick maturing type should be selected rather than the big massive type or the leggy dairy bred type. The Shorthorn's tendency is to on growing instead of fattening or ripening at an early age. This makes Shorthorns especially desirable under some conditions, but for the purpose of growing and finishing at an early age, it is probable that the other breeds are superior. However, as stated before, there are undesirable types in all breeds, and the man who wants to get the right kind of cattle must know the type best suited to the purpose for which he wants them.

The selection of a breed is perhaps less important within the above limits than the selection of the right type of the breed. The blocky, thick-fleshed, early maturing type is essential no matter what the breed may be. It is a mistake to choose something different from the neighbors' cattle merely because it is different. There are several advantages in having the same breed as your neighbor has, one of them being the ability to the use of the other man's bull or to exchange bulls with him in order to save investing in a new one at frequent intervals. Buyers will come farther to look at two or a dozen herds than to look at one herd, and if the breeders are above petty jealousy there are many ways in which they can help each other if their

cattle are of the same breed. Business men in cities have been quick to see the advantage of the community idea. The merchants of the same line are grouped and so are the lawyers and the physicians to a considerable extent. They all do best in communities or groups and so do breeders of any particular class or breed of livestock. The cattleman's fancy should govern his selection of a breed also to a certain extent. No cattleman will do so well with a breed that he does not like as with one that he admires. Market preferences may have something to do with it also. Some butchers are prejudiced in favor of certain breeds, and if they are the natural buyers for the cattle, their tastes should not be disregarded unless other considerations are of more weight. These prejudices are not always based on facts, nor do all buyers hold them, but the principle of giving the market what it likes is a sound one in the cattle business as in any other.

CHAPTER IV

THE TYPE OF BULL AND COW

The correct general type of beef cattle has been described on page 11, and also in the descriptions of the breeds, pages 15 to 21. A few general suggestions as to selection which may be applied to pure-bred or high grade herds follow:

The bull is generally described as half the herd, and his influence on all the calves of the herd justifies this pre-eminence. For the purpose of getting good cattle the bull should be selected with care in two essential points—his individuality and his breeding. An inferior individual, no matter how well-bred he is, should never be used, for, in some future generation, his inferiority is just as apt to show in his descendants as the inferiority of some of his ancestors in his own case. This of course applies only to bulls whose progeny are to be kept in the herd and not to those which are to be used for the purpose of getting cattle for market only. The bull should be representative of his breed and a good individual all around—low to the ground, square built or blocky, with good scale or size. A bull that weighs more than he appears to weigh is usually a good kind provided he is not unduly heavy in forequarter, where much of the weight of such a bull is sometimes found. His back should be strong and straight, well held up, not swayed. His head should show masculinity, and so should his behavior, but this last should not be confused with evil temper or excitability. If his eye is prominent and placid his temper is usually good; but if he is unduly nervous and excitable he is likely to be a vicious bull or to become one. At best such a bull will be hard to handle. An honest countenance, that indefinable indication of a good temper, is easily recognized but not so easily described, and it goes with a satisfactory bull from the standpoint of management.

Another important point in a bull is constitution. This is indicated by a thick neck, firm muscles, deep chest and big barrel, good sized nostrils, a hide of medium thickness, apparently a little too big in places, an easy carriage and general appearance of vigor and

thriftiness. The legs of a bull are also an important feature. His hocks should be of proper conformation to stand the strain to which they will be put in service, especially when he increases in weight. The strongest hock is neither very crooked nor quite straight. In breeding cattle for the market a bull that is strong in essential points may be forgiven minor weaknesses, for it is impossible to obtain a perfect animal.

Another point of importance in selecting all cattle is the quality of easy or quick fleshing, and this is not always accompanied by the greatest smoothness in laying on of flesh. If a cow is a little "lumpy" or patchy at the tail head, or "corrugated" along the ribs when in good flesh never mind—it indicates a quick-fleshing animal, and at Pennsylvania prices for feed beef cattle are not likely to get so lumpy fat at an early age that they are objectionable. A bull from a good growing ancestry is also important. There is such a thing as getting a bull too compact and tidy—when it means that he lacks size. Some of these watch-charm bulls are beautiful to look upon, but the breeder of pure-bred cattle and the raiser of grade cattle should both remember that they *must have pounds to make profits.* Coarseness is a great evil, but so is the other extreme. The pedigree of the herd bull is of special importance to the breeder of pure-bred cattle. It should be viewed in all lines, not merely on one side as some are accustomed to scan it. With good cattle back of him in every direction, an untried bull is a comparatively safe breeding proposition; otherwise he is uncertain.

THE BULL'S AGE

The age of the bull is a matter too often viewed in the wrong light. Many people will not purchase an aged bull, most of them wanting a yearling that is ready to serve cows. No greater mistake is made in breeding cattle than the policy of allowing a sire of good cattle to go to the butcher because of his age. Many a bull that has been tried and found to be a good breeder has had to go for beef because of this prejudice against aged bulls. The beginner especially should profit by an opportunity to secure a sire that has been proved as a getter of good stock, provided of course that the bull is a breeder and is not vicious or breachy. The first cost of the good bull is one of the greatest hindrances to the improvement of beef cattle in the East. Dairymen who can realize on the milk of their cows can afford to sell their bull calves at low figures and do so. Many cattlemen seem to think that they should be able to buy beef-bred bulls at prices to correspond with those of dairy bred bulls. It should be remembered that the breeder of beef cattle has no other product from his cow than the calf; that this calf with the care and feed necessary to make him an attractive bull at a year old could have been made into a good steer, worth fifty dollars or more, and therefore breeders of pure-bred cattle cannot afford to supply bulls at low prices. They would better steer them.

The buyer's side of the bull proposition should also be considered. If the bull is a good one he can, with proper feeding, be used for three years and sent to market at a price that will pay a large percentage of his first cost as a yearling if not all of it; and there is a comparatively small amount to be charged to the improvement of the herd or to the increased value of the steers marketed from the herd. Counting the increased value of every calf got by a good bull at $2.00, he is a profitable investment at $150.00 even if he dies at the end of his period of service. Looking at the wrong end, the first investment, has kept many a herd of cattle from improving or has utterly destroyed its usefulness. Usually bulls good enough to head beef-producing herds can be had at $100 to $150 and sometimes a little less in this State if bought young enough. Bulls to head herds of pure-bred cattle used to produce bulls and heifers for other breeders cost more, in proportion to their quality and their pedigree. The stockyards bull, a calf or young bull in poor flesh bought at the yards for a few cents a pound, is another hindrance to the beef cattle industry. He always goes to grade herds and to the very herds that need a prepotent, improving sort of bull the worst. Sometimes he carries disease with him, "pinkeye" or abortion, and sometimes he is so uncertain as a getter that he causes a loss of many times his value by failure to get cows with calf. The quality of his produce is always uncertain because he is a grade himself and lacking in prepotency. The average stockyards young bull is a lottery, and like all lotteries the chances are against the man who invests in him.

THE BREEDING COW

The cows selected for the herd that is to produce beef should be selected with care whether they are pure-breds or grades. Good-sized, roomy, robust cows; with breadth but not coarseness; big of barrel, loose of hide, short of leg, neat of head, mild of manner, placid of countenance, with a decidedly feminine expression, are the kind; as the bull should be masculine so the cow should be feminine in her general characteristcs. Masculine-type bulls beget masculine bulls and feminine heifers; and feminine type cows produce heifers of the same kind, and the most masculine bulls. A "steery" cow does not produce a bull of such masculinity as does a cow of pronounced feminine type. It is Nature's plan and will prove itself in spite of the judges in the show-ring who often fail to observe the feminine characteristics in placing the awards on breeding cows but look for the points of a steer.

One of the important advantages of a "feminine" cow is her ability to give milk for her offspring. Cows that are good milkers, as a rule, are good and regular breeders—they do not get too fat to breed. There is moreover a close relation between milking qualities and motherhood. Cows that are not good milkers do not perpetuate themselves, because nature forbids it. Animals that nourish their offspring insufficiently will ultimately be crowded out and this is true of the cow as of all other animals. The practical value of a good

milking beef bred cow is so plain that it hardly needs mention. Her calf is started well, is kept going and develops rapidly, for there is no feed for a calf or any other mammal that will take the place of mother's milk. The beef cow should give milk for six months, and some of them give it longer even when calves are allowed to run with them constantly, a practice which is supposed to be destructive to milking qualities and is so in many cases.

Here is another important fact—the cows which milk most and lose flesh most rapidly when suckling calves are the quickest-fleshing cows. They milk down rapidly but they recover flesh quickly when relieved of the strain of milk production. These I call "solvent" cows, and their owners are usually solvent too. This characteristic of quick fleshing usually accompanies good milking, but not persistent milking of course. Beef bred cows are not, as a rule, all-the-year milkers nor is it desirable that they should be. Heavy and persistent milking means loss of beef qualities inevitably as generation succeeds generation, and ultimately the form and lack of flesh of the dairy cow will succeed the form and flesh of the beef cow. If the above statements as to milk and breeding and milk and fleshing are correct, and experience of many cattle breeders has proved them, it is an absurdity to claim that breeders of beef cattle need pay no attention to milk. Milk enough is vital to their success as cattle raisers and they cannot afford to neglect it any more than they can afford to make it a leading object of their breeding. So get "lady" cows, feminine type, with good udders, and they can be found in all the beef breeds. Let the steery cow alone as you would the bull that lacks masculinity.

CHAPTER V

MANAGEMENT OF THE HERD

This general subject includes many points which are discussed more fully in another chapter. The general aim should be to so manage the beef producing herd that the breeding part of it should be kept in good thrifty condition, producing calves regularly and raising them properly. Losses from irregular breeders, aborters, unthrifty or diseased cows cannot be borne with the narrow margins beef producers must carry on their business. Cattle, feed, grass and manure must be handled as economically as possile. This may lead to departures from ideal methods, or the methods considered best or even those considered essential by most writers on the subject of keeping cattle. But if managed according to the ideas of some authors, our cattle would be in too high flesh to produce best results, would cost too much for feed and require too much labor for attention. The idea of the beef producer should be the greatest economy in all things consistent with good results. The fattening should be confined to the steers or other animals intended for market. The others should be kept on good maintenance rations, without any attempt to fatten them except in case of show animals. More and stronger calves will result from this method than from the pampering of the cattle in an endeavor to have them look fine all the time.

THE BULL'S MANAGEMENT

The management of the bull should be of the sort best calculated to keep him in vigorous condition, and of a young bull, to develop him properly. He should have sufficient feed to keep him in fair flesh. Ususally a beef-bred bull can use more corn in his rations than is commonly prescribed for bulls, and that without injury. There is a great difference in bulls in this respect. Some are very quiet, easy keepers, and others are more restless and require more feed to keep

them in fair flesh. There is no better feed for a breeding bull than oats, especially if he has much service. Oats, corn, mill feed or oil meal, any grain that he relishes, with hay or fodder of any kind in proper proportions, should be fed in sufficient quantity to keep him in fair flesh. Beef getting bulls should not be allowed to become thin and so continue. Flesh is hereditary as other physical qualities, and the product of a line of thin bulls is not apt to be a race of thick-fleshed cattle. While in a single generation probably no deterioration in this respect would be noted, yet the keeping of bulls for generations in thin flesh will in time have its effect. To get naturally fleshy cattle, we must breed from cattle kept in flesh but not necessarily fat. Some bulls will require some grain on good grass to keep in proper condition, others will not, and these last are to be preferred as progenitors of beef cattle. A young growng bull requires feed to develop him properly. He cannot develop on what would be sufficient for a steer of his age, because he frets and runs more than the steer, and so uses up more energy and requires more feed to keep him growing.

An experienced breeder estimates that the difference in feed necessary to develop a young bull properly is 25 to 50 per cent. more than required for a steer of the same breeding and age. Many cattlemen who buy young beef bulls fail to realize this fact, allow their bulls to shift for themselves, and as a result the bulls do not grow and develop as they should, whereupon they blame the breed or the breeder when their methods are wholly responsible. A few go to the other extreme and so handle and feed their bulls as to make them unduly expensive and at the same time interfere with their usefulness. The eye of the breeder should tell him how his young bull is developing and guide him as to the quantity of feed he should have. As indicated above, there is considerable latitude in the ration, and, as a rule, it should not be kept as narrow as called for by scientific standards, because the activity of the bull uses up more heat or fat forming elements than in case of cows or steers.

THE BULL'S QUARTERS

The best place to keep a breeding bull is in a lot which will furnish him with sufficient grass for himself and another animal and in one corner of which is a barn or shed which may be left open at all times. The lot should be well fenced and a couple of barbed wires on the fence will increase his respect for it. The barn should be located near a corner so that it may become a part of a small enclosure used as a breeding pen into which it should open. Here cows may be brought for service, the bull turned or led in and immediately after service returned to his own quarters while the cow should be quietly removed. A chute similar to bull stocks or dehorning chute but without top crosstimbers is often a convenience in this pen. A well broken bull will give no trouble, as a rule, in handling at time of

service if he can be easily led or turned in or out. It is well to close the other door of his shed and keep him in a short time until the cow is beyond sight or hearing. In taking him from place to place, if he is not easily led, a cow should always be driven with him. Usually he will go anywhere without trouble in this society.

NEVER TRUST A BULL

While the bull should be handled and broken to lead from his youth up, he should never be played with or teased. Handle him in a business-like way, without hesitation and without undue bustle or noise. Above all he should never be allowed to get his attendant "in a corner" or completely at his mercy. As a rule beef bulls are not vicious, but nobody knows what a bull is going to do or when he is going to do it, and due caution should always be observed in handling him. Disregard of this has cost many human lives and will cost more as time goes on. *Never trust a bull,* is a motto that should be posted in every bull barn. In high condition a beef bull is less disposed to be troublesome than when in merely ordinary flesh; but even then in crisp weather he may from exuberance of spirits, if not from viciousness, do considerable damage. Usually it is well to have a companion of his own kind in his lot—a cow preferred—and in the management of the herd it will often be necessary to put one there until there is reasonable assurance that she has got with calf. A solitary bull is often given to too much walking around the bounds of his enclosure and more fretting than he would do if he had company in his lot. Allowing the bull to run with the herd is a policy open to several objections yet when it is known that the herd is on a safe pasture, that there is no danger of losing track of time of service, etc., it is permissible with beef bulls for a time at least. As a policy it has many more things against it than in favor of it; but circumstances should govern such things.

The bull should, of course, have a ring in his nose and, as a rule, he should be handled by a halter and a strap attached to this ring. It is not usually best to handle a beef bull with a staff unless he is known to be hard to handle without it. A staff seems to irritate a bull about as much as it controls him and it is of doubtful value except where absolutely necessary. It is not a good thing to have around a beef bred bull that must be so handled. Many directions as to handling the bull have been given by writers whose experience must have been with vicious animals, and one does not wonder that their bulls were vicious if these methods were followed. Some give the bull a prison which is none the less a prison because it is not all under roof. He is prodded from one part of this to another after service while the herdsman and others are in security on or around the fence or wall. Others keep him stabled and use him like a wild beast in a cage. Others put him on a trolley, tied by the ring in his nose, a constant irritant. All such methods are likely to make a

vicious bull out of a kindly one and are needless with most beef bred bulls that are kept in such flesh as bulls of this kind should carry. Any beef bred bull that requires such handling should go to the shambles—he is too dangerous, troublesome and costly to keep. Do not tie up a bull by the nose ring for a long time anywhere. Let him have all the freedom and exercise he needs—those two great preventives of viciousness and guaranties of potency in all breeding animals. Feed him well enough to keep him as quiet and contented as a vigorous breeding bull ought to be. If he is a show bull or is expected to be one do not keep him where he must constantly keep his head aloft (and his back down) to see out of his enclosure. Feed him in a box on the ground. Do not try to work him in a tread power or anywhere else. Seee that he has shade, which will usually be provided by his house or shed if not otherwise. In all respects treat him rationally, handle him carefully and he will give little trouble.

SERVICE

As to extent of service, much depends on the age of the bull and his state of development. A beef bred bull that is well developed may be allowed to serve a limited number of cows at a year old, but as a rule he should be six months older than this. We have used a bull before he was a year old on a very few heifers, but such service is not to be advised. The bull, unless well developed, is apt to be a slow server at this age and if he is shortlegged, a shallow pit or excavation must be provided for the cow's hind legs in order that he may serve her. The number of cows that a bull may serve in a year depends on the bull and the distribution of the services. A bull well fed and cared for can get a large number of calves without impairing his usefulness provided they are scattered throughout the year. Excessive service consists in breeding too many cows in a limited space of time rather than in breeding too many in a year. An ordinarily vigorous bull will get 100 calves a year if the cows come to him at the proper intervals, but when they are nearly all bred in spring and in fall probably 60 is about the usual limit. Average bulls in service do not usually get over 50 calves a year, but the bull's possibilities seem to be an unknown quantity. We know of no tests on this subject, nor are any necessary as a rule, because few bulls have access to cows in excess of their ability in this State or elsewhere. One service is sufficient in each case. Two services a day may be allowed mature vigorous bulls without injury or even more provided there are few days of this kind. Some very young and also some aged bulls are slow servers. Oats is about the best remedy for this defect. Drugs rarely accomplish any good purpose in stimulating sexual activity of a bull. If oats do not make him vigorous and sure send him to the stockyards before he fools you into wasting a lot of time.

in getting cows in calf. When a bull's cows begin to "come back" or fail to "catch" at first service, begin to stimulate him with oats; and if a few more cases occur, let him go or substitute a sure bull promptly. A great deal of time may be lost, calves may come at wrong time, cows calve at seasons when the ordeal is especially trying to them, and calves be brought into the world at unpropitious times because of the failure of a bull to turn off his cows in calf.

PUBLIC SERVICE

One of the greatest hindrances to the improvement of cattle is the accommodating bull owner, who allows his neighbors to breed cows without paying service fees. It would seem that the man who keeps good bulls and allows his neighbors to use them might be called a philanthropist and that he might improve the stock of his community by such a benevolent course. He usually not only fails to benefit any one, but actually lowers the quality of the cattle in his neighborhood by allowing free service. Sooner or later he will get weary of keeping bulls for his neighbors. Then having educated them to free service they will breed to anything to get free service, will not patronize any other good bull and so will not encourage anyone to invest in one. Communities in which bulls give free service nowadays have no good bulls, while those where breeders of cows pay two dollars or more per calf have them. Charge a reasonable service fee and collect it, and more will be done to improve the cattle of the community than can ever be done by giving people free access to good bulls. Do not allow cows to be bred that have any unnatural discharge from the vagina. They will not get with calf, and they may communicate disease to the bull. Do not breed the bull to cows from any herd which has contagious abortion for fear of contaminating the bull and through him the whole herd. When more than one cow in a herd aborts it is safe to call it contagious abortion, though it may be merely sympathetic.

HANDLING THE COW HERD

The beef-bred cow is not usually so sensitive a creature as the special dairy cow, but she should be handled as if she were so. Excitement among cattle means loss of condition, injury to the milk they are giving their calves, and trouble in handling them afterward. Men who handle cows of whatever breed or kind should be sensible, not given to sudden outbursts of any kind, quiet movers among them. It is a good sign when a man can walk around among a herd of any kind of cattle without all or most of them jumping up.

"Wild men make wild cattle," and, worse than mere wildness, they often make cattle costly to maintain. The quiet beast is the cheaply kept one always.

The first essential to the proper handling of a herd of beef cows is a "good man with cattle." The second is good fences and enough of them for their proper confinement and handling without racing and exciting them to move them about as desired. It is often found that cows are very tenacious of their herd fellowships and even of their rights to remain on their accustomed range; and they will return to their former companions or range unless they are prevented by proper fences. I would suggest that before any man engages in breeding pure-bred cattle of any kind he sees that his fences are in good repair. Otherwise he will have trouble with his own bulls and cows or with those of somebody else. Many a quarrel has had its origin here—especially by misalliances between pure-bred cattle of different breeds or pure-bred females and a scrub bull, the result of lack of good fences. Probably no stock on the farm will require less attention than a herd of beef-bred cows, but they should be seen often, and so accustomed to proper handling that they will not be hard to deal with when the time comes. A good cattleman with a salt bucket can take cows almost anywhere, but like all females sometimes they are perverse and then means of putting and keeping them where desired are invaluable.

WHEN THE CALVES SHOULD COME

A good calf never comes amiss; but there is for each locality if not for each cattleman a season when it is best to have the calves arrive. And whatever the season, it is more convenient to have as many as possible at the same time or close together. It is much easier to attend to a dozen calves of the same age than to have that many of different ages and sizes, and the labor cost of producing beef cattle must be kept as low as possible if it is to be carried on under present conditions anywhere.

Two seasons are preferable for the advent of calves—spring and fall—and each of these has some things in its favor. Much depends on the disposition to be made of the calves and a great deal on the character of the farm on which they are to be raised. In this State, which is a grass-producing rather than a grain-producing State, the great majority of cattlemen will prefer spring calves for several reasons: The first is, because their dams may be wintered when dry previous to calving at about half the cost of wintering cows suckling calves, and at a minimum cost for grain or other concentrated feeds. Dry cows require less attention and less barn room as well as less feed. The open shed system of wintering, which is most conducive to vigor of constitution, may be used for dry cows and for others too,

but the milking cows will usually be put into warmer quarters. As to the calves if they are to be pushed forward for baby beef they can be finished in the fall or early winter of the year following birth and have the benefit of two seasons grass with the cost of only one winter's feeding. Or if they are to be raised for feeders the same holds good. It is true that it is possible to make the fall calf into a marketable steer, or baby beef, the next fall or winter but only by more forcing and under ordinary conditions he will not be able to make the weight and take on the finish required at so early an age. Those who favor fall calves believe that the calves will come to grass in condition to utilize it the first summer of their lives, and that this fact enables them to be finished as cheaply though not at as early an age as the spring calf. They say that the calf in its second summer has more age, and that with this advantage in age it will "ripen" better than the younger calf which has a tendency to keep on growing rather than to ripen for market. Those who favor fall calves also assert that the cows milk longer when they come in fall or winter. By the time the cow comes to grass her milk is failing, but grass stimulates production and the calf on a milk and grass ration goes forward very fast. These things may all be true, but it seems that in such a territory as this, when grain for winter feeding is dear, those who argue for the spring calf have the best of it. Moreover as spring is the natural time for cows to calve their natural period of mating follows soon and it is easier to get them in calf again than during the winter. As a rule the beef-bred cow suckling a calf is not hard to get in calf again unless she is an excessive milker or is out of her normal condition for some other reason.

AGES OF SHOW CATTLE

There is, however, a certain class of beef-bred calves which must come in the fall for best results—those intended for the show ring. Ages of show cattle date from September 1, and the calves that come soonest after that date have a very evident advantage over later ones in their opportunities to develop for exhibition. They can be shown in calf classes all the next year, and so on. And here it might be well to warn the casual observer that the cattle he sees in the show ring, as a rule, are close to the limit in age. A "calf" may be more than 365 days old, if the shows comes late; and a "yearling" may be 23 months old, or even older than two years at a late show. The majority of the yearlings shown nowadays are practically two years old, and the calves are around one year old. Sometimes ignorance of these facts leads the prospective buyer of breeding cattle astray, because he expects in a yearling, or an animal not long past that point, such development as he sees in show-ring yearlings. This is of course impossible, and moreover

cattle that are fitted to the limit for show purposes are not the kind that will prove most satisfactory to the ordinary buyer. It is safer and better to buy cattle that are in ordinary good condition than to buy those fed heavily for showing at our great fairs and expositions, where the hot competition leads feeders to feed to the utmost limit of the animal's flesh-carrying capacity. Proper management of beef cows will keep them breeding regularly; will maintain them in fair flesh and rugged health; will perpetuate their ability to give milk enough to raise their calves well; and will maintain them in the cheapest and least laborious way consistent with the above essentials.

This is a big subject, even bigger than it looks, for it involves the prosperity of the cattle-raiser. Keep the cows too well, with warm barns, high feeding and little exercise and the inevitable result is trouble. There will be too few calves. The calves that arrive will have a harder time getting here and less constitution than they should have to make good feeding and grazing animals. A dainty eater is about the worst affliction a cattleman can have, and it is usually the result of an improperly kept cow. Just as many if not more ills come from the other extreme, too poor keep for cows. Starved cows cannot produce strong calves, and they cannot give milk enough to develop their calves properly. The strain of producing and nourishing a calf cannot be met without undue exhaustion, and the cow herself is liable to become a victim of any disease that is common to her kind. Tuberculosis, abortion, or some derangements of digestion known of old as "hollow horn," "wolf in the tail," etc., are liable to attack the cow that is debilitated. The best results come from the medium course, whereby cows are kept vitally strong, always ready to eat and willing to exercise. Healthy cows, strong calves, able to rustle and turn coarse fodders and grass into flesh, will result from this common-sense treatment, which involves less labor and less feed than the one extreme and more feed and little more trouble than the other.

WINTER SHELTER

The first consideration in the keeping of cows for the production of beef cattle is the cost thereof. Into this many elements enter, such as shelter, equipment for feeding, fencing, cost of feed, cost of labor, and the value of the land on which they are kept. All these should be considered by the man who expects to raise beef cattle.

The question of the shelter necessary in the climate of Pennsylvania will bring forth much discussion. Some cattlemen believe that very little shelter is necessary; others that warm barns are essential to the economical keep of cattle. Perhaps the difference in climate

owing to latitude and altitude may have something to do with this difference of opiuion, but long-taught ideas of good care for cattle as much as anything. For over a century Pennsylvania farmers have been taught that warm barns are a necessity, that in them is the only humane way to house cattle, and that they save feed enough to make them a profitable investment. As a rule Pennsylvania barns, aside from those in the southwestern part of the State, are of this character. But considering all things it is doubtful whether these warm barns are not productive of as much harm as good. The writer hereof believes that there is no other shelter for beef cattle equal to an open shed or a barn whose doors may be kept open constantly, provided the barn or shed is not subject to frequent drafts of air. This especially for dry cows, young animals and steers. The advantages of such sheds or barns are that the cattle are always supplied with fresh air and light, those great givers of health and constitution; then cattle may go in and out at will, and will get the exercise needed for health and development; they may be handled easier and more cheaply; and the cost of such shelter is much less than that of barns which conform to the old ideas of warmth. Tuberculosis prospers iu the warm barn that is not properly lighted or ventilated, and most barns of this nature are not. Cattle kept in warm quarters are more liable to colds than those kept in sheds, are less rugged and the future health of such herds less likely to be good. Dehorned or hornless cattle can run together without injury as a rule in sheds or open barns; but it is well to make provision to tie them up at feeding time should this be found necessary. Cows with calves at foot are best kept in box stalls while the calves are quite youug; but they too may soou be transferred to the shed and be the better for it.

No beef cattle need be stabled in a warm barn. All should spend a part of each day in the open, around a straw stack or in some other sheltered place. The properly-fed beef auimal cares little for any weather if kept dry and out of the wind. All this sounds heretical no doubt to many cattlemen of experience; but in the long run I believe the correct system of housing beef-bred cattle is to give them shelter, dry beds, protection against the wind and constant access to the open air. The objection to this plan will be made that more feed is necessary than in warm barns. It may be so, but the excess if any will be on the less expeusive roughage, so that the actual cost of the feed may not be much greater. But admitting that more feed is necessary it is worth more to have a rugged herd than to run the risk entailed by the average warm barn, and the lesser cost of the shelter may partially at least offset the difference in feed. It is worthy of note in this connection that some of our most progressive cattle breeders are resorting to the shed system, and some of our modern experiment station and college barns are being constructed on the open-air principle instead of being made tight and warm.

THE WATER SUPPLY

The best water for cattle is that which comes from a running stream, a spring or a well in summer, and that which comes from a spring or well directly to the cattle in winter. Springs that do not freeze are better than water from streams containing ice in winter, and water that comes directly from the well to the cattle is also better. The reason is the same in both cases, the temperature of the water. Cattle watered from a stream or trough where the water becomes ice-cold will not drink as much as they should drink in cold weather. The spring and well water is not ice cold and they use more of it and do better for that reason.

The question may arise here, If well and spring water is better than ice-cold water, would not warm water be still better? No. That question is an old one, and it has been decided by experience that in the long run there is no advantage in warm water. Every man knows the tonic or stimulating effect on himself of a drink of cold water in winter if it is not too cold for comfort. Thoughtful breeders of dairy cattle who have furnished warm water for their cows in winter have discontinued the practice. It costs too much and it was no advantage to the cattle. In fact it was the reverse, and probable for the reason above indicated, it lacked the tonic effect of the cold water. But water may be too "good" for cattle.

Our ideas of "good" water are not the cattle's idea as a little observation will teach. Every observing cattleman has watched them wade into the stream and turn their heads and drink of the muddy water when they had clear water just ahead. More than one man who has furnished his cattle with perfectly clear water has found it better for them if he has mixed a little clean earth with it. There may be and probably are some needed mineral elements in the mud which is in the water; but whatever the reason experience shows that the cow does not choose the perfectly clear water all the time. The water supply arranged so that the cattle may go to it at will is best; if this is not practicable they will not usually drink more than twice a day and often only once. It depends largely on the succulence or dryness of the feed and the state of the weather. In winter if cattle must be turned to water it is best to allow them access to it twice a day. There is always the possibility that some of the herd will not get water if turned to it only once, especially if not closely watched, and the second opportunity should be given for this reason if for no other. It is sometimes true also that cattle will not all want water at the same time of day, and the safest plan is to give them an opportunity to get it in the morning and in the evening in winter, or at any time it may be found that they will relish it most, which will depend somewhat on the feeding. Cattle will usually graze toward their water or go to it after grazing a while in the morning. This indicates that

they relish their water best after feeding, and when being fed and watered it will be found best to water them after feeding—they will drink more then and stay longer at the water. It is not necessary to mention the amount of water necessary for cattle further than to say that they should have all they want of it, and that there is no other possible course in profitable feeding than to give them all they want.

CHAPTER VI

HERD MANAGEMENT

MANAGEMENT OF HEIFERS

The ultimate purpose for which a heifer calf is to be used should determine the method of feeding, care and management. If the heifer is destined for the block rather than for breeding purposes, she should never be allowed to lose her "calf-fat," but crowded from birth to market at as early an age as possible as described in later pages on finishing yearling or "baby" beef. It is a well known fact among cattle feeders that heifers will make equally as rapid gains as steers and probably fatten a little more rapidly until they are 15 to 18 months of age. During the past two or three years, the discrimination formerly shown by buyers against heifers has been abandoned if marketed as prime yearlings weighing from 900 to 1,000 pounds, as shown by the fact that mixed loads of steers and heifers have been able to top the Chicago market during the summers of 1909, 1910 and 1911. If, however, they are not marketed before they are 20 months of age, they become more angular, more paunchy and are frequently with calf, all of which tend to decrease the dressing percentage and the quality of beef, hence lower their value as compared with steers of equal age and condition.

When heifers are to be reserved as breeding animals, an entirely different method of management must be adopted. The purpose in view should be to secure the largest possible amount of growth without permitting either an excessive amount of fat or an extreme degree of emaciation to interfere with their future use as matrons in the herd. It is only in rare instances that the inheritance of early maturity is so marked that heifers will become fat enough to injure them before they are 12 months of age. If cows of greatest scale combined with quality are desired, they should be fed rations which will

furnish a sufficient amount of protein and mineral matter to meet the needs of growth and of concentrated feeds to keep them in good condition during their growing period.

Clover, alfalfa, cowpeas or vetch are the cheapest sources of protein in winter, and when combined with corn silage make ideal roughage for wintering breeding heifers. In addition, they should receive during their first winter a sufficient amount of grain to maintain their condition. An excellent grain ration can be made of corn-and-cob meal and linseed meal mixed in proportion of 10 parts of the former to one of the latter. An equally as efficient, but under most conditions a more expensive ration, can be made of corn, oats and bran in equal parts. In summer an abundance of good grass with ample shade and pure water throughout the season is entirely satisfactory without grain for growing heifers. If pastures become short, they should be supplemented either with soiling crops or with silage to prevent any loss in flesh. During the second winter, a ration consisting entirely of roughage may be used without grain, provided it is made up of the best of forage crops properly cured.

In order that health and thrift may be insured throughout the life of the individuals, breeding animals should be kept in the open as much as possible, provided with protection against wind and rain and always have a dry bed. Where good heavy sod has been formed in pastures and not grazed off too closely during the preceding summer, the young breeding stock should be permitted to run over it in winter whenever the condition of the ground will not subject it to injury. With this system of management, heifers not bred before they are two years of age will develop into the most useful type of breeding animals, provided they have the proper sort of ancestry. They should never be allowed to run with either mature or immature bulls after they are four months of age until they are placed in the breeding herd. In orded to insure uniform development throughout the herd, they should be divided into groups quite similar in age, size and condition which will simplify the matter of feeding and obviate the necessity of individual feeding.

AGE TO BREED HEIFERS

It seems to be generally conceded that the best age to breed heifers of the beef herds is about twenty-one months, having them drop their first calves when about two and a-half years old. Heifers of the beef breeds are not usually bred so early as those of the dairy breeds. Where spring calves are required, it is often the practice not to breed heifers until the spring after they are two years old, it being held that the heifer up to that time should devote all her energies to the development of her own body. On the other hand, many cattle growers breed their heifers at fifteen to eighteen months of age, holding the

breeding habit and maternal instinct should be established early, and that they get a better development of the cow. Some of them believe too that barrenness is more likely to occur in cows that are not bred before they mature. It is probable that the development of the heifer affords the best guide, some being as suitable for breeding at fifteen months as others at twenty-four.

Prof. Thomas Shaw says: *"It would seem at least approximately correct to say that the relation between the time of the first mating and the period of usefulness covered by the life of the animal would be as one to six. That is, if the period of usefulness covered by the average animal were twelve years, it may be bred at the age of two years." Some successful cattlemen breed their yearling heifers and allow them to miss as two-year-olds. They claim that by this method they derive all the benefits of early mating with none of its disadvantages .

FEEDING

The time has come when the average value of land necessary to produce crops in sufficient quantity to maintain a beef cow in Pennsylvania is less than in any of the Central or Middle Western states which have formerly supplied cattle useful for feeding purposes. In other words, breeding herds of beef cattle may be maintained at less expense than in states considered especially adaptable to the production of beef.

The breeding herd should be kept largely on grass and roughage, with little grain throughout the year. The purpose in view should be to utilize as largely as possible unmarketable roughage, such as corn stover and straw, to maintain the fertility of the soil by feeding leguminous crops, such as alfalfa, clover, cowpeas and vetch and returning the manure to the land and to convert into profitable pastures much of the waste land growing up in brush and weeds.

Where the sole object in maintaining a beef herd is to produce cattle for the feed lot, it is advisable to have all the calves drop as nearly as possible during the months of April and May, as the cows may be turned to pasture with calves following during the summer and will require a mimimum amount of attention. The calves should be weaned at the close of the grazing season and handled as directed in later pages where the discussion of "Baby Beef and Raising Feeders" is given.

An abundance of good grass will insure the beef cows entering winter quarters in best possible condition after having suckled their calves during the summer. Having no other function to perform, the maintenance of dry cows during winter is a simple matter. Whenever possible they should be allowed to run over the permanent pastures

*Feeding farm animals, p. 112.

supplemented with hay from leguminous crops and corn silage or corn stover. A limited amount of grain may be necessary during the late winter months in order to have them in good strong condition at calving time. When leguminous crops are not available as roughage it will be necessary to add a feed rich in protein to the ration in order to secure a strong vigorous calf crop the following year.

The only marked attention to the cows will be given at the time of calving. When weather conditions are suitable, this should occur in the pasture; when the season is such as to make this inadvisable, a roomy box stall, from which all manure has been removed, should be bedded with fresh litter for the purpose. With cows of heavy milking tendencies, the udder should be milked entirely dry once daily until the young calf is able to take all of the milk. If at any time a tendency to scouring is noted on the part of young calves which are runnning with their dams it is due to an oversupply of milk, which should be removed. After calves are a month old they will be able to take all of the milk, even from deep milking strains of beef cattle.

SKIM MILK CALVES

When calves are to be raised on skim milk it is much better to have them drop in the fall, as milk and butter fat command a higher price, there is usually a more abundant supply of labor and the cows are dry during fly-time. The beef cows which are used for dairy purposes during the winter months will have to be fed largely on concentrated nitrogenous feeds in order to stimulate the flow of milk, thus making the cost of maintenance much higher than when calves are allowed to suckle their dams during the summer.

WINTERING BEEF COWS

There is little experimental evidence as to the relative value of different feeds for wintering beef cows. At the Illinois Station (Bulletin 111) thirty grade Aberdeen-Angus cows, which had nursed their calves during the breeding summer, in thin yet thrifty condition, were divided into three lots and fed as follows:

Lot 1—Silage, clover hay and oat straw.

Lot 2—Shock corn, clover hay and oat straw.

Lot 3—Corn stover, clover hay and oat straw.

These rations are available on most of the farms in Pennsylvania, hence the results of the test are given in the following table:

Weight.	Lot 1.	Lot 2.	Lot 3.
	lbs.	lbs.	lbs.
Average Weight at Beginning,	860.3	858.5	859.8
Average Feed Consumed Daily per Cow:			
Silage,	16.65	.....	.....
Shock corn, clover hay,	.....	8.70	.....
Corn stover (42 days),	.....	.....	21.67
Shredded stover (98 days),	.....	.....	10.29
Clover hay,	3.50	3.50	1.56
Oat straw,	9.50	10.83	8.19
Average consumed per cow (240 days), acres,	.952	1.02	1.14
Average weight at close of test,	1,010.4	964.9	916.3

It may be noted that the cows were all quite uniform in weight when this test was started, but that the silage-fed cows in Lot 1 were much heavier at the close, indicating that silage is superior to either shock corn or corn stover, for wintering cows. The average consumed per cow does not take into consideration the grain produced in addition to the roughage fed. When the money value of both roughage and grain is considered and the proportionate value of roughage only is charged to the cows, the results indicate that .3428 of the total feed value of crops on one acre was required to feed each cow in Lot 1, .3475 A. in Lot 2 and .2046 A. in Lot 3. Immediately after calving, the cows lost materially in weight when fed on their previous rations used for maintenance. To overcome this loss, the amount of feed was increased quite rapidly until the cows in Lot 1 were consuming 38 lbs. of silage and 5 lbs. clover hay; those in Lot 2, 20 lbs. of shock corn and 5 lbs. of hay, which was sufficient to maintain weight while nursing calves.

The conclusions from this test are:

"1. It is assumed that the maintenance ration of a pregnant breeding cow should be regarded as the ration necessary to permit of sufficient gain in weight to account for the weight of the foetus.

"2. Breeding cows of the beef type may be wintered without grain provided they are given all the corn stover and oat straw they will consume during the early part, and supplemented with a small amount of clover during the latter part of the season. While the cows in Lot 3 used in this test were so fed, and while they weighed 57.53 pounds more per head at the end than at the beginning of the test, this method is not recommended because the cows so fed lacked thrift at the end of the test.

"3. The corn plant fed either in the form of shock corn or silage supplemented with a limited amount of clover hay proved satisfactory rations for wintering beef breeding cows.

"4. Although the rations fed the cows receiving silage were smaller than those given the ones receiving shock corn, the gains were larger.

"5. Before calving, the general conditions of the cows in Lots 1 and 2, the lots receiving silage and shock corn respectively, was about the same; however, those cows in Lot 1 which gave birth to calves during the experiment showed more thrift than did those of Lot 2 under like conditions.

"6. The amounts of feed consumed in terms of the acreages involved in producing these feeds were as follows: Lot 1 (silage fed), .9528 acre; Lot 2 (shock corn), 1.0388 acres; Lot 3 (corn stover), 1.1402 acres.

"7. A comparison of the three rations in terms of relative efficiency of the acreages involved by taking into consideration the money value of the grain grown on the acreages involved but not fed the cows is as follows: Lot 1 (silage), .3428 acre; Lot 2 (shock corn), .3475; Lot 3 (corn stover), .2046.

"8. Figuring corn at 35 cents a bushel, clover hay $8.00, shock corn $5.59, corn stover $2.25 and oat straw $1.50 per ton, it cost 49 cents a day per head or $1.47 a month or $6.873 for 140 days to maintain Lot 1 (silage-fed); $.046 a day or $1.390 a month or $6.504 for 140 days to maintain Lot 2 (shock corn-fed); $.031 a day or $.937 a month or $4.374 for 140 days to maintain Lot 3 (corn stover-fed).

"9. It cost 37 cents more to winter a cow fed silage for 140 days than it did one fed shock corn. However, the cows fed silage—Lot 1—gained 150.10 pounds, while those in Lot 2 gained but 106.19.

"10. In this test it took approximately twice as much feed to maintain a cow when suckling a calf as it did during her pregnancy.

"11. The average daily cost of keeping the cows that calved in Lot 1 was 7.56 cents, while the average in Lot 2 was 6.84 cents. Before calving, the average daily cost of keeping a cow in these lots was 5.8 cents and 5.5 cents, respectively.

"12. The data with reference to the relative efficiency of rations fed Lots 1 and 2 for the maintenance of cows and gains on calves after calving are not based on a sufficient number of animals to eliminate individuality, hence should not be regarded as conclusive.

"13. The cows in Lot 1 (silage-fed) ate less oat straw than did either of the other two lots, which may be accounted for by the fact that they were eating the whole of the corn plant. That is to say, there was practically no waste.

"14. Corn plant fed in the form of silage is more palatable than if fed in the form of shock corn, which may be the cause of its being more efficient for the maintenance of beef breeding cows.

"15. The amount of feed required for maintenance is apparently less than that given in the German standards.

"16. The experimental data presented will materially aid in a study of the practicability of raising calves and producing our own feeding cattle in the corn belt."

The ultimate disposition of beef breeding cows is on the block as "butcher stuff." A careful study of statistics will show that the highest prices are generally paid for this class of cattle during the spring months just before "grass cattle" begin to arrive on the market. In preparing them for this trade, rations similar to those recommended for steer feeding purposes can be used to advantage, though more preparation in the way of grinding or soaking grain is advisable. The cows should generally be marketed before they are thoroughly fattened, as the difference in market value between a finished cow and one that is three-fourths fat is not sufficient to justify the additional cost necessary in the last stages of the fattening period.

WINTERING BREEDING COWS ON SILAGE AND COTTONSEED MEAL

Selection of rations on which beef breeding cattle may be successfully maintained during the winter at a comparatively low cost is one of the most important problems before livestock producers. In the past the feeders of beef cattle have depended upon shipping cattle from Western markets for finishing on Eastern grown feeds, as two-year-old steers could be purchased for less than the cost of producing them locally. The large ranges of the West are being divided into smaller farms, and their supply of cattle is diminishing while the demand is continually increasing. The result of this will be the production of feeding cattle on lands that are especially adapted to the business, capable of producing grass in abundance, well supplied with water and shade and of such topography or distance from markets that they cannot profitably be utilized for the continuous production of cereal crops.

There are large areas in almost every section of Pennsylvania, which, although too steep to plow, are especially adapted to the growth of pasture grasses and in every way favorable to the production of beef. In many of the counties where timber has been cut off, the hillsides might as well be producing grass as brush and weeds. The problem after the pastures have been established is to grow a sufficient amount of roughage to carry cattle through winter at a minimum of expense. The demand for hay has increased so rapidly during the past few years that many farmers would sell it rather than feed it to cattle, were it not for the fact that they realize the necessity of keeping roughage on the farm in order to maintain the fertility of the soil.

This experiment was undertaken to find some feed that would produce a large amount of food nutriment per acre than hay, equally as well adapted to the feeding of breeding cattle, supplemented with a minimum amount of concentrated feeds which would furnish the digestible nutriments not provided by the farm grown crop. Corn silage was selected as most nearly meeting these conditions. It is adaptable to a wider range of soil conditions than any other crop except grass, it produces a large amount of food nutriment per acre, is palatable, succulent, easily grown, harvested with comparative ease, and can be stored at less expense for building than any other forage crop. In addition to these advantages, there is other form in which the corn crop will be entirely consumed by livestock, thus it increases in value by being placed in the silo. Cottonseed meal was used as a supplement because of the fact that protein, in which corn silage is quite deficient, could be secured in this form cheaper than from any other source and because of the large percentage of protein that could be fed in very small quantities, thus reducing the expense for transportation and labor in feeding. Previous investigation has also shown that the laxative tendency caused by heavy feeding of succulent feeds is materially reduced by the addition of cottonseed meal to the rations.

THE PLAN OF THE EXPERIMENT

The pure-bred Shorthorn cows were purchased in Mercer county, Pennsylvania, and ten pure-bred Aberdeen-Angus cows were selected from the College herds to be used in the test. The Shorthorns were in very thin flesh, having been kept entirely on grass during the summer and fall of 1911. They had produced calves the preceding year, but were not bred at the time of purchase. The Angus cows had raised calves during the summer and were re-bred to produce another crop during the winter and spring. Because of the better fall pastures in the central part of the State, they were in much higher condition at the beginning of the test. Each group of ten cows was allowed to run loose under an open shed used for steer feeding purposes, adjoining which was an open lot. The floor space in each shed, exclusive of that occupied by mangers and feeding alley, was 420 square feet. The area of the open lot was 780 square feet. The cattle were confined in these lots from the beginning of the experiment on December 1, 1911, until the close, April 19, 1912, a period of 140 days. While the housing and shelter were ample, as shown by results secured, a greater area in the open lot would be desirable.

METHOD OF FEEDING

The corn silage was removed from the silo twice daily and fed to the cows directly after weighing, in such quantities that there would be none left in the mangers one hour after feeding. Cottonseed meal was fed once daily at the rate of one pound to each cow. This was distributed over the entire amount of silage in order that the amount consumed would be determined by the amount of silage. One lot of cows was bedded with sawdust, the other with straw. Bedding was distributed at such intervals as the condition of sheds and lots justified.

TABLE I—Showing Feeds Fed and Refused

	10 Shorthorn Cows.			10 Aberdeen-Angus Cows.		
	Cottonseed meal.	Corn silage.	Refused silage.	Cottonseed meal.	Corn silage.	Refused silage.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
December 1-15, 1911,	140	8,000	181.	140	8,700	74.58
December 15-29,	140	7,700	.. ..	140	7,775	.....
December 29-January 12, 1912,	140	7,700	.....	140	7,700	.....
January 12-26,	140	8,400	9.25	140	8,400	.....
January 26-February 9,	140	8,400	11.50	140	8,400	19.00
February 9-23,	140	8,400	8.00	140	8,400	57.00
February 23-March 8,	140	8,400	33.50	140	8,400	130.75
March 8-22,	140	8,400	54.75	140	7,550	309.75
March 22-April 5,	140	8,400	87.25	140	7,000	.....
April 5-19,	140	8,400	15.50	140	7,600	135.75
	1,400	82,200	400.75	1,400	79,425	726.83

Table I shows that the Shorthorn cows did not consume quite as much silage during the first two weeks as did the Angus, due to the fact that they had never been fed from the silo previously, while the Angus cows had received the silage in their ration the preceding winter. After the first six weeks, however, both lots were fed at the rate of 60 pounds per head daily, which proved to be ample for satisfying their appetites. This amount was fed to the Shorthorn cows throughout the remainder of the winter, with less than 1 per cent. of waste. During the latter part of February, however, the Angus cows refused to eat the full allowance, although they were increasing in weight and some of them were suckling calves. This result

confirms that of preceding tests at this station with steers fed largely on roughage. When thin they will make very rapid gains, but as they improve in condition, their consumption of feed decreases, finally reaching a point where the appetite for roughage is only sufficient for maintenance. It is probable that a decrease in food consumption would also have been noted in the Shorthorn lot if the test had been continued through a longer period of time. At the close of the test, both lots of cows were turned on pasture without grain and had made slight gains after two months of grazing, at which time this report was written.

As beef cattle are maintained largely for the purpose of producing manure to be used in increasing the yield of crops, a record of the amount of bedding and manure produced in the Shorthorn lot was secured. During the 140 day feeding period, 9,851 pounds of straw were used in bedding the ten cows, and from this lot 88,405 pounds of manure were received. It would require, under these conditions, the straw from approximately one acre of small grain to bed each individual and the production of 8,840 pounds of manure. A large amount of straw could have been utilized to advantage where cows were closely confined as in this test, though under farm conditions where the cows were permitted to run in pasture during suitable weather, the required amount of bedding could be materially reduced.

SUMMARY OF EXPERIMENT IN WINTERING TWENTY BEEF BREEDING COWS

Length of experiment	140	days
Initial weight of 20 cows	21,436.7	lbs.
Final weight of 20 cows	24,729.66	"
Total gain	3,290.84	"
Average daily gain per cow	1.17	"
Total feed consumed:		
Corn silage,	16,039.75	"
Cottonseed meal	2,800.00	"
Average daily feed per cow:		
Corn silage	57.64	"
Cottonseed meal	1.00	"
Cost of feed:		
Corn silage at $3.50 per ton		$280.69
Cottonseed meal at $30.00 per ton		42.00
Total		$322.69
Average cost of feed per cow		16.13
Bedding used per cow:		
985 lbs. wheat straw at $8.00 per ton		3.97
Labor in feeding		2.00
Total expenditure,		$22.00
Value of manure per cow:		
8,840 lbs. at $1.50 per ton		6.63
Valne of increase in weight:		
164.5 lbs. at 5c. per lb.		8.22
Total value		$14.85
Net cost of wintering cow		$ 8.22

The data presented in the summary is based upon prevailing local prices of feeds throughout the State during the winter of 1911-12. Corn silage is valued at $3.50 per ton, which is equivalent to 70c. per bushel for corn, thus allowing a very material profit in its production before charging it as feed. It required four tons of silage to winter each cow, which is equivalent to one-half of an acre when corn yields 40 bushels per acre or one-third of an acre when the land will produce a 60 bushel corn crop. The weather conditions during the progress of the test were the most severe of any ever recorded at the local weather bureau, the temperature frequently running below zero and at times as low as 23 degrees below. The results were thus secured under the most unfavorable rather than favorable circumstances and should be easily duplicated in the future. As the cows have not lost weight in pasture without grain from the 19th of April to the 29th of June, it is reasonable to suppose that they will maintain their weight throughout the summer where ample range is provided to insure an abundance of grass throughout the season. With pasture at $1.00 per head per month, the total cost of maintenance throughout the year will be $15.22 per head, or with pasture at $2.00 per head it will amount to $22.22, either of which estimates allow ample profit from the growing of crops and a reasonable rate of interest on land kept in permanent pasture. Only a few of the cows have produced calves during the progress of the experiment. The oldest of these weighed 52 pounds when six months of age, which, at prevailing beef prices, would allow a profit of from $10 to $15 on the cost of keeping the cow. This system of farming will permit a uniform distribution of labor throughout the year, a maximum profit in the production of crops, the maintenance of soil fertility at a minimum expense and the utilization of all rough and broken land capable of producing grass. It will also solve the problem of securing feeding cattle at less cost than they can be purchased on the central markets of the country, eliminate loss in transit and incurs a better bred lot of cattle in those sections of the State where the system is followed. The State of Pennsylvania is especially adapted to the production of grass and silage, which are the two crops considered in this experiment. The local demand for beef is greater than in any other section of the country, which should insure profitable production of beef within its borders through a long series of years.

MANAGEMENT OF BULLS

All bull calves not intended for breeding purposes should be castrated before they are six months of age. Those which are pure bred and of sufficient individual excellence to be retained for breeding purposes should be so handled that there will be no break in their development from birth to maturity. This is best accomplished by allowing them to have all the milk from their dams until they are

six to eight months of age and by giving them access to grain in order that they may learn to eat before weaning. An excellent grain ration for a young growing bull may be made up of equal parts of corn, oats and bran or whole oats when not too expensive, but corn alone is sufficient while suckling the dam. They should be fed approximately five pounds daily until they are one year of age, after which the amount should be such as to keep them in strong vigorous condition. After they are six months of age, they should be separated from all females and given a paddock of sufficient size that they may take an abundance of exercise. Rings should be inserted in their noses as a matter of protection to attendants, when they are one year old. Previous to this, they should have been broken to lead at the halter, but afterward always handled by means of the ring. The yearling should be provided with an abundance of pasture during the summer and all of the roughage he can consume without waste in winter. Grain should be fed according to the condition of the individual, the kind depending upon the character of the roughage. If the roughage is made up entirely of feeds rich in protein, corn may be used for grain. If, however, the bull has only timothy red top, fodder or other non-leguminous roughage, liberal use should be made of bran or linseed meal as a supplement to corn and oats. He should not be allowed to serve cows until 15 months of age . It is advisable, whenever condition warrant, to postpone this until he is 18 or 20 months. After he has reached a serviceable age, he should be kept entirely separate from the cows, except during the breeding season. Only one good service should be permitted during a period of heat.

In the maintenance of a herd of cows used for the production of beef calves, the use of pure-bred and registered bulls is essential for profit from the business. It is almost certain to result in loss if the farmer uses scrub, dairy or grade beef bulls as sires. As a general rule, an individual capable of siring the best type of steers can be purchased from breeders at prices varying from $75 to $150 when old enough for service, used in the herd for two or three years, marketed for beef at cost or an advance over the original purchase price, and thus the only outlay necessary to secure good grade steers is the care and feed necessary for maintenance. The breeds which have found most favor are Aberdeen-Angus, Hereford and Shorthorn, though a few Galloways and Polled Durhams will be found in every beef producing section of the country. Unless the producer has a large herd it is necessary to dispose of a sire just at the time when he has reached his greatest period of usefulness from 3 to 5 years of age. Frequently such a sire whose calves show his ability can be purchased from a similar herd or exchanged. The only objection to the use of mature bulls is that they are apt to be ugly in their disposition and may possibly be carriers of infectious or contagious diseases. Ugly dispositions usually come from improper management during early periods of life, such as close confinement in the stable without exercise, teasing on the part of irresponsible persons or fear on the part

of the attendant. The beef bull should be handled from calfhood in such manner that he will recognize the authority of his master, never under any circumstances being allowed to realize his strength. Fences should be so constructed that there is no possibility of their being pushed over or broken down, all gates should be constructed of strong material and of a height equal to that of the fence. The bull should never be allowed to run with the cows, but should always be led to and from the barn for service and then turned into his paddock.

FEEDING SURPLUS BREEDING STOCK FOR MARKET

When beef herds are kept in most desirable condition, any failure to breed upon the part of an individual usually results in their becoming fat enough for market. During the late fall and early winter months, thin dry cows can usually be purchased at a very low price, as their owners do not, as a rule, have a sufficient number on hand to justify finishing them for market. In selecting cows for feeding purposes, care should be used to see that they have good mouths, teeth showing that their age is not too great, good colors showing that they have a predominance of beef blood and good type showing that they will finish rapidly into desirable market animals. They should have short, wide, clean-cut heads, short legs, deep bodies, straight backs and rumps, wide loins and good quality. The factor of condition is one that is controlled by price. They should be fed liberally on roughage with a sufficient amount of ground grain to insure rapid fattening and marketed from the first of April to the middle of June before being turned on pasture.

FEEDING BULLS FOR MARKET (See Figs. 13, 14 and 15)

This industry is successfully carried on in many sections of the country, although there is little direct evidence as to any general method of feeding and management. As the cost of maintenance is higher than in feeding steers, the margin between buying and selling price must be much greater. A thin bull is marketed either as a "bologna" or as a feeder. Many of the latter, especially if young and not too "staggy," are castrated and dehorned before being put in the feed lot. The improvement in condition causes a marked refinement throughout so that some of the individuals may be sold as straight steers. Because of the larger percentage of cheap meat in the neck and shoulders, finished bulls or "stags" sell at a discount as compared with steers. In selecting feeding bulls, short-legged, stocky individuals should be chosen, with deep bodies, straight backs, quality and beef breeding. Discrimination should be shown against those that are flat ribbed, narrow in hind quarters with long narrow heads and shallow bodies. They can be fed on wider and cheaper rations than steers, but will make equally as rapid, though more expensive gains.

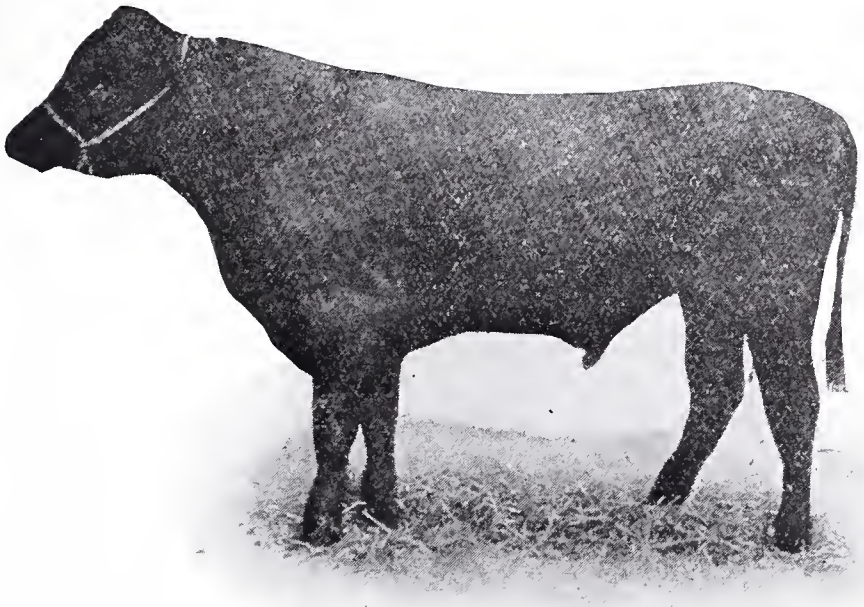

Fig. 13. A FEEDER BULL.

This type goes to the distilleries of Pennsylvania to consume the slops

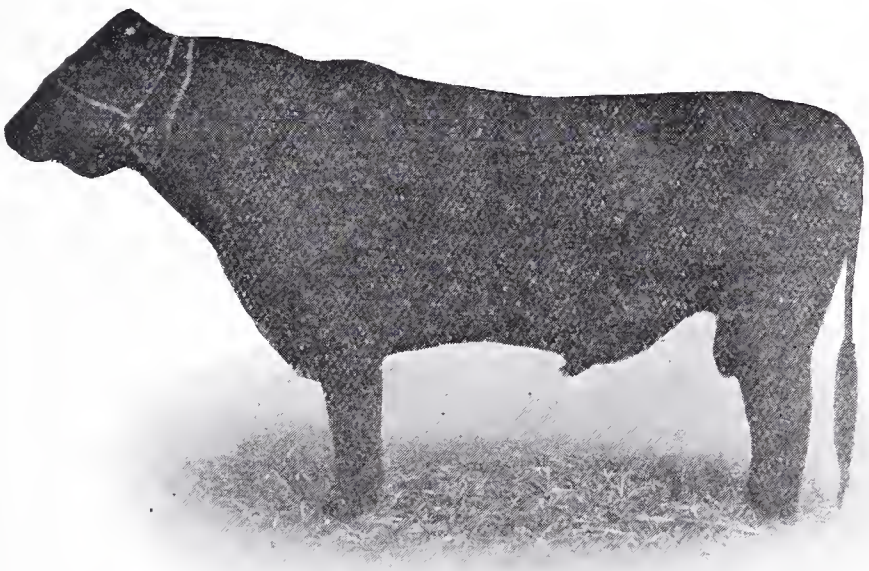

Fig. 14. A BOLOGNA BULL.

His carcass is used to make bologna sausages.

Fig. 15. A CHOICE BUTCHER BULL.
His meat is sold as beef in markets which require low-priced meat.

Bulls should be marketed between the first of February and first of July in order to insure the greatest price per pound. The chief demand for feeder bulls comes from distillers for the utilization of distillery slops. Their age and natural hardiness permit them to stand heavy feeding on bulky rations with great success. The method of handling and stabling them makes their disposition less objectionable than is in the farm feed lot.

CHAPTER VII

THE CALVES

The cow should have rather light feed for some days after the calf is dropped. She is better off with no grain for the first twenty-four hours other than about half a pound of oil meal and about a pound of bran. Plenty of water, not ice cold, should be given from the start. As the swelling goes out of the udder the grain ration may be increased so long as it results in profitable production.

If it is intended that the calf shall take the milk, the cow will be fed somewhat differently from a dairy cow. She should be kept in medium flesh and fed to produce what milk the calf can use economically. She will not need so nitrogenous a ration as a dairy cow. She may be fed a larger proportion of corn, corn stover, etc. Timothy hay is not usually an economical feed even for a beef cow. Red clover, alsike and alfalfa are much better. When one of the last named is fed, the grain may consist for the most part of corn. Unless a legumi nous roughage is fed, it will be necessary to provide a nitrogenous supplement ,as oil meal, cottonseed meal, gluten feed, distillers' grain, etc.

The greater the importance of milk production the more nitrogenous ration* should be up to the limit of the profitable dairy ration. A cow should not fatten, but rather lose flesh when fed for milk production and when suckling a calf. It seems that the cow produces a richer milk when losing flesh than when gaining. This appears to be in general true irrespective of the quantity.

Cows should have access to roughage at all times, even though it be the cheapest form. Not that they will eat continuously, for they will

*For discussion of the general principles of feeding, see the chapter on Feeds or Nutrition.

not, but they do not waste it, and they should be allowed to fill up at their leisure. The cow eats rapidly while she is at it, and then takes plenty of time for rumination. The grain need not be fed more than twice a day and if time is valuable and the cows become accustomed to it once a day is sufficient.

The large paunch of the cow (about 5 gallons), enables her to store away a large amount of feed, and the length of the intestines (about 185 feet), indicate that the nutrients are absorbed rather slowly. The necessity then for frequent feeding is less than with other classes of animals.

The question of spring or fall calves is not one which each grower must decide for himself in the light of his own conditions. On the range fall calves are impossible and there is no question that in any case they are more trouble than spring calves. Spring is the natural season for calves to come and if they are to run with the cow or pasture is plentiful it is the most profitable season. Where summer dairying is prevalent as in the proximity to creameries and ice cream factories, spring calves will be found most convenient and profitable. The milk flow will be greatest when there is a market for it and the calves may be raised very cheaply on skim milk and shelled corn. Spring calves require much less shelter and care than fall calves. If milk or butter is sold and there is a greater demand for it in the winter than in the summer then fall calves are best. If the calves are intended for show, they will have a better chance if dropped in the fall as the age is nearly always computed from the first of September. Fall calves are weaned about the time grass is ready for pasture, so that there is less shock when the milk is taken away from them. Prof. Thos. Shaw says: *"The best season to have calves dropped, all things considered, is from November 1st to March 1st." He says they winter better as yearlings and are ready for market at a more favorable age.

About the only records compiled comparing fall and spring calves are of the dairy herd of the Ultuna Agricultural College of Sweden. Their records extend from 1873 to 1880, inclusive. It was found that the average weight of spring calves at birth was 66.3 pounds, of the fall calves 60 pounds. During the milk feeding period (21 weeks), the spring calves gained 230.1 pounds, the fall calves 246.7 pounds.† These differences may easily be accounted for by different methods of feeding during winter and summer.

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*The Feeding and Management of Livestock, p. 29.
†Experiment Station Record.

WEIGHT AT BIRTH

According to a German authority the weight of calves at birth is from one-twelfth to one-fourteenth the weight of the dam. This authority places the weight at birth as follows:*

	Birth Weight.
Light calves,	48—66
Average calves,	96—92
Heavy calves,	97—110
Very heavy calves,	115—128

The average weight of twenty-five pure bred Shorthorns and Angus calves dropped at the Pennsylvania State College was 72 pounds. The range was from 65 to 90 pounds and there was practically no difference between the two breeds. The average weight of one hundred grade Guernsey calves was 70 pounds. The average weight of the Shorthorns and Angus cows was fully two hundred pounds more than that of the Guernsey, and of course they carried more flesh. The ratio between the weight of dam and weight of calf at birth will depend to a very great extent upon the condition of the dam.

The absolute weight of the calf will depend upon several factors, chief among which are the following:

1. Individuality of the dam.
2. Condition of the dam.
3. Sex of calf.
4. Length of period of gestation.

By individuality is meant all those qualities inherent within the cow herself. It includes breed characters as well as all those qualities which differentiate one cow from another within the breed. Some cows normally produce larger calves than others. An excessively fat cow or an excessively lean cow will not produce so large a calf as one that is in medium condition. Bull calves are generally heavier at birth than heifer calves. The normal period of gestation is variously given from 280 to 284 days. The records of the dairy herd at the Pennsylvania State College indicate that the latter is more nearly correct, for mature cows rather than low. The heavy calves were usually carried longer than the light ones.

RATE OF GROWTH

There are many records of calves gaining $2\frac{1}{2}$ pounds or more per day for the first six months or year, but this is not to be expected. The normal gain of the Shorthorn and Angus calves at the Pennsylvania State College seemed to be about 65 pounds per month. These

*Henry, Feeds and Feeding, v. see 34 Vol. +I, p. 972.
†Kansas Bulletin No. 126.

calves sucked the cows and received grain and hay; none of them were pastured. At the Kansas Station †the average gain of 130 calves fed on skim milk with different kinds of grain and roughage was 1.58 pounds per day. The gains varied from 1.14 pounds per day for one lot of ten on reduced grain ration to 2.02 pounds for another lot on rather full grain ration. When skim milk was compared with whole milk feeding and calves running with their dams, the skim milk calves gained 1.51 pounds per day, the whole milk calves 1.86 pounds and the calves running with dams, 1.77 pounds.

In Iowa ‡beef calves fed skim milk and grain gained 1.67 pounds per day.

SUCKING CALVES

Calves sucking their dams are undoubtedly less trouble than those raised by hand, but cost more where milk or butter has the market value it has in Pennsylvania. There are two ways of raising the calves on the cows. One is to allow them to run with the cows at all times, as is done on the range, the other is to keep the calves away from the cows suckling them only at milking time. The cow whose calf runs with her seldom produces more milk than the calf can take. This is an advantage where cows are kept for the calves alone. It does not often pay in Pennsylvania to keep a cow for her calf alone except for the production of pure bred calves that are to be sold for breeding purposes.

It may sometimes be found desirable to let the calf suck the cow, taking a part of the milk only. This method saves the labor of feeding the calf and avoids the necessity of teaching it to drink. It also produces better looking calves in general during the milk period and there is less danger of loss. If the calves are to have whole milk, this is probably as satisfactory a way of raising them as any. The calves should always be required to take the first part of the milk, as that being less rich in butter fat is not so valuable. The amount which the calf may be allowed to take will depend on the relative value of the calf and the milk. The objections to this system are that the cows teats are always wet and not comfortable to milk, and have a greater tendency to crack especially in cold weather than if kept dry. Unless intended for show purposes, baby beef, or fancy breeding stock, sucking calves will need no grain before weaning. They should though, if spring calves, have good pasture, and if fall calves, have plenty of good hay.

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†Iowa Bulletin No. 48.
‡Nebraska Bulletin No. 68.

Comparing sucking calves with those raised on skim milk, A. L. Haecker says:

"As to the quality of the calves in the two lots, it was quite easy at the end of the fifth and sixth periods to pick out the sucking calves as they were rounder in body and had better coats, but at one year old this difference could not be detected."

HAND FEEDING

That it is perfectly possible and often more profitable to raise even beef calves by hand on skim milk has been demonstrated many times. At the market price of butter, whole milk whether fed by hand or sucked by the calf is too expensive a feed to be used extensively.

The cost of raising skim milk calves has been compared to that of raising them on whole milk many times. According to the Nebraska bulletin above quoted, five grade Hereford calves and one cross-bred Shorthorn-Jersey were divided into two lots of three each. Ignoring the labor of feeding the calves and milking the cows, and crediting the skim milk calves with the butter fat produced by their dams at 18 cents per pound, the following was the cost of a pound of gain for each lot:

Skim milk calves,	$0.028
Sucking calves,	0.086

These figures assume the following market prices for feed:

Whole milk, $1.00 per cwt.

Skim milk, 15 cents per cwt.

Flaxseed meal, $3.00 per cwt.

Ground oats, 25 cents per bushel.

Ground corn, 25 cents per bushel.

Alfalfa hay, $4.00 per ton.

Pasture for cows, 25 cents per week.

Pasture for calves, three to six months old, 12½ cents per week.

The very low price at which most of these feeds are quoted as compared with present prices would raise the cost of the skim milk calves somewhat, as the sucking calves got no other feed than their dam's milk and pasture.

In Kansas the cost of raising calves by the various methods was as follows:

	Cost per head.	Cost per 100 lbs. gain.
Skim milk lot,	$5 27	$2 26
Whole milk lot,	19 13	7 06
Lot with dams,	12 00	4 41

The skim milk and whole milk calves were fed a grain ration of equal parts corn and Kaffir corn and all the alfalfa hay they would eat. The grain was figured at fifty cents per hundred pounds, the hay at four dollars per ton, the skim milk at fifteen cents per hundred pounds, and the whole milk at market prices for butter fat, 21.08 cents. The twelve dollars charged against the calves with dams, is the estimate cost of pasture for the season. No account is taken of the labor of milking the cows and feeding the calves.

When weaned, the calves with dams lost four pounds per head the first week, while the whole milk calves gained about eight pounds, and the skim milk calves gained twenty-two pounds per head. In fact the skim milk calves gained more the week after weaning than in any other week during the two preceding and the four following. "Up to the weaning time the calves running with their dams looked slicker and fatter than those raised on either skim milk or whole milk."

At the close of this experiment the calves running with their dams were placed in the feed lots in comparison with those raised on skim milk, and whole milk. The results in the feed lots are shown in the following table:

	Number of calves.	Months fed.	Average gained per head.	Daily gain per head.
Skim milk,	10	7	440	2 10
Whole milk,	10	7	405	1 93
Running with dam,	22	7	422	2 00

It is seen that the skim milk calves made the best gain. The feed records show that the skim milk calves produced 100 pounds of gain for 439 pounds of grain, while the whole milk calves required 470 pounds of grain and the calves running with dams, 475 pounds of grain for 100 pounds of gain.

In comparing a group of beef calves fed on skim milk with another which sucked their dams, the Virginia Station found, according to Bulletin No. 172, that, "The group of calves fed whole milk (sucking, made the largest gain, but at the highest cost per day and per pound of gain. They presented better appearance before weaning, but at 8 months of age there was little difference either in weight or appearance between those developed on whole milk and those on skim milk."

GRAIN FOR SKIM MILK CALVES

A large variety of substances have been tested for feedng in connection with skim milk, to take the place of the butter fat removed. Among these may be mentioned cod liver oil, corn oil, cottonseed oil, flaxseed meal, oil meal, etc., but nothing has yet been found quite so satisfactory as shelled corn or corn meal.

The Iowa *Station fed four lots of skim milk calves with different grain supplement as follows:

	Oil meal.	Oatmeal.	Corn meal.	Corn meal and flax-seed meal.
Milk,	3,760 lbs.	3,752 lbs.	3,760 lbs.	3,750 lbs.
Hay,	1,478 "	1,481 "	1,478 "	1,484 "
Oil meal,	429 "	.....	.....	.....
Corn meal,	.....	.....	533 "	601 "
Oat meal,	.....	605 "	.....	.....
Flax seed,	.....	.....	59 "	.....
Grain in 74 days,	483 "	498 "	489 "	509 "
Average daily gain,	1.63 "	1.68 "	1.65 "	1.72 "
Dry matter per pound of gain,	4.13 "	4.31 "	4.32 "	4.16 "
Cost of feed per pound of gain,	2.4 cts.	2.4 cts.	2 cts.	1.8 cts.

The oil meal was estimated at $1.00 per cwt., the oatmeal at 83 cents per cwt., the corn meal at 40 cents per cwt., hay at 25 cents per cwt., the flax seed meal at $1.07 per cwt., and skim milk at 10 cents per cwt. It would thus be necessary to apply the present market prices for feeds in order to find the cost at to-day.

*Iowa Bulletin No. 48.

The Kansas Station* fed shelled corn, corn chop, whole Kaffir corn, whole corn and ground Kaffir corn, equal parts, and a mixture consisting of shelled corn, 10 pounds; ground Kaffir corn, 10 pounds; whole oat, 6 pounds; wheat bran, 6 pounds; oil meal, 2 pounds, and dried blood, ½ pound with the following results:

	Feed consumed per 100 lbs. gain. Pounds.			Average daily gain.
	Skim milk.	Grain.	Roughage.	
Corn chop,	878.59	107.71	333.39	1.59
Shelled corn,	773.04	112.47	305.25	1.74
Whole Kaffir corn,	901.91	101.23	523.68	1.44
Ground Kaffir corn,	829.93	72.78	491.16	1.58
Shelled corn and ground Kaffir corn,	777.79	164.75	325.63	2.02
Mixed feed,	880.19	192.94	333.37	1.74

In commenting they say that "the calves began eating the shelled corn at from two to three weeks old, they relished it and were less subject to scours than those fed corn chop; Kaffir corn seems to be too hard for young calves to masticate and digest." There seemed to be no advantage in furnishing the calves a large variety in their grain ration.

In Virginia† comparisons were made of "shelled corn, shelled corn and bran, four parts of the former to one of the latter by weight, corn meal and bran in the same proportion, and cracked barley and bran also in the same proportion."

"The best results were obtained from shelled corn. The calves did not consume as much corn meal per day as shelled corn, nor did they make as large a rate of gain. It did not require as much shelled corn as corn meal per pound of gain."

"Bran was used to great advantage in teaching the calves to eat grain, but no advantage was secured from adding bran to a ration of shelled corn, to supplement the skim milk, either in rate of gain or in appearance of the calf."

The Kansas Station also raised calves on buttermilk, whey and hay tea. While the butter milk calves did not make as good gains as the skim milk calves, they were fairly satisfactory and the butter

*Kansas Bulletin No. 120.
†Virginia Bulletin No. 172.

milk calves had less trouble from the scours than the skim milk calves. The calves on whey and hay tea gained very poorly and these substances cannot be recommended for raising beef calves.

The grain should not be mixed with the milk, but fed afterward. It will take the calf's attention and prevent his sucking at the ears of his mates.

Where a number of calves are running together, they should be fastened in stanchions while being fed their milk, in order that each one may get his portion. This also seems to prevent sucking the ears of each other.

There are a number of calf feeders on the market, but it is doubtful whether any of them are equal to the tin pail. Their merit is supposed to be in their preventing the calves from taking the milk too fast. The difficulty of keeping them clean is against most of them.

GENERAL DIRECTIONS

Prof. Curtiss of Iowa, says* "Practically all the difficulty in raising calves on skim milk may be attributed to one or more of these causes—over-feeding, and conditions of milk or unsanitary condition of the stable. Over-feeding is the most common error. Skim milk is less digestible than whole milk. The safety lies in light feeding. Allow the calf to follow nature, eating the colostrum, or first milk, and suckle the dam for four or five days. When the calf is removed it should be fed from the pail on new milk, fresh from its dam, and the best results will come from feeding small quantities at frequent intervals. The intervals may be increased, so that by the time the calf is two weeks old, it will be getting its ration in two feeds—at milking time, morning and evening.

"The calf should continue to have new milk until three weeks old, at this time skim milk may be gradually added. By the time the calf is a month old, it may be fed entirely on skim milk. Eight to ten pounds per day will be sufficient for most calves at the beginning. This may be increased up to twelve or fifteen pounds when the calf is six weeks or two months old, and later to 18 or 20 pounds for vigorous, well grown calves. Cleanliness is of prime importance.

"It is not advisable to begin doping the skim milk with something to replace the butter fat removed. A teaspoonful of dried blood may be added to correct derangement of digestion. A little shelled corn and oats should be kept in a trough where the calf may nibble at it

*Breeders' Gazette, March 4, 1908.

at will. Furnish a fresh supply each day. No ground feed will be necessary before the calf is eight or ten months old. Use only the best of clean, sweet hay.

"Calves fed in this way will gain from 1½ to 2 pounds per day during the milk period."

According to an experiment at the Pennsylvania Station.*

"During the feeding trial of 161 days, the calves fed whole milk gained 1.77 pounds each per day, and those fed skim milk gained 1.35 pounds each per day.

"The calves fed whole milk consumed two and one-half pounds of perfectly dry substance for each pound of increase, and those fed skim milk consumed a little over three and one-half pounds of perfectly dry substance for each pound of increase. The calves which were fed whole milk ate over one-fifth less grain and hay than did those fed skim milk.

"Counting whole milk at one dollar per hundred weight and skim milk at twelve cents per hundred weight, it cost nearly ten cents (9.9 cents) to make a pound of increase when whole milk was fed, and nearly three and one-half cents (3.4 cents) to make a pound of increase when skim milk was fed, or nearly three times as much in the former as in the latter case"

In this experiment, the calves fed on skim milk, to which a porridge of linseed meal was added, made a less gain per day than those fed on skim milk without the addition of any substance. The amount of food eaten per day, and the amount of perfectly dry substance required to produce a pound of gain, was increased by the addition of the linseed meal. The cost of making a pound of increase was greater, therefore, being over four and one-half cents (4.7 cents), as compared with less than three and one-half (3.4 cents), when skim milk was fed without the addition of any substance.

WATERING

A plentiful supply of fresh, clean water is necessary to the growth of all young animals, even though getting all the milk they care for.

Armsby states : †"It should never be forgotten that rapid production, involving the utilization of relatively large amounts of feed requires the consumption of a corresponding amount of water for the physiological purposes." The water should be of such temperature as to be palatable to the animal. The great importance of water is in-

*Pa. An. Rept. 1891.
†Bureau of Animal Industry, Bulletin No. 108.

dicated by the fact that it constitutes more than 80 per centum of the increase in weight of the young calf. It was found in Kansas, as reported in Bulletin No. 126, that calves two or three months old drank almost ten pounds of water per head daily, even when on a skim milk diet. It was also noticed that the calves drank several times a day, sipping a little at a time; even after their ration of milk they would take a swallow of water. An automatic waterer situated a little above the surface of the ground is the best arrangement for supplying this want."

WEANING

Calves are usually weaned at from four to six months of age, although when intended for show purposes and sometimes for baby beef, it may be found advisable to continue the milk diet longer. The time for weaning will depend for most part upon the milk supply, and the demand for it from other quarters. Beef calves give better returns for milk fed than dairy calves and it may therefore be continued longer.

It makes little difference with the calves whether they are weaned gradually or abruptly after they are four or five months old. Sucking calves will worry if weaned abruptly and will probably lose no more weight as they adapt themselves to their new conditions more quickly. It may sometimes be found advisable to shut off the milk gradually from hand fed calves, but in general it will be found much less trouble to stop at once.

CHAPTER VIII

THE STEER

Admirers of the horse, the cow, the hog and the sheep have many a time and oft, in prose and in verse, recorded the virtues of these animals as money-makers and mortgage-lifters, but few have arisen to point out the conspicuous merits of the steer. He requires no large investment for barns or shelter, no costly equipment for feeding, no expensive labor to secure his product, which he safely stores within his own hide. He converts into money roughage otherwise wasted or unmarketable. Garlic in the grass or weeds in the hay have no terrors for him. He turns the grain heap, the hay stack, the straw pile and the pasture into money and manure. Most diseases pass him by. He is subject to no epidemic as is the hog, to no risk of destruction by internal or external parasites as is the sheep; to no great depreciation by slight blemishes as is the horse. He is always in the fashion, always convertible into cash regardless of age, size, condition and breeding. He exacts no fine balancing of rations, and when getting ready for market uses a larger proporton of home-raised carbonaceous feed than any other animal. He leaves the fertility on the farm when he carries himself to market—not only the fertility of grain but that of roughage which he has made available for the use of plants.

With all this he has made the nations which consume his flesh the masters of a large part of the globe. This "imperial flesh food of the race" has made the race imperial. Fortified by roasts and steaks the Anglo-Saxon goes on conquering, extending his sway over the races who know not the steer and his products. The richest nations are those who grow cattle and eat beef; the richest agricultural states are those which raise or fatten steers; and the richest agricultural county in this country feeds the most steers. It is a Pennsylvania county too, and many another Pennsylvania county needs the steer to help market its grasses and to restore fertility to the lands which have been depleted by the sale of stuff which should have been marketed through the steer.

WHY CATTLE OF BEEF BREEDING ARE MORE VALUABLE FOR SLAUGHTERING PURPOSES THAN THOSE OF "SCRUB" BREEDING

Beef cattle are more valuable on the block because they yield a higher proportion of carcass to live weight, their carcasses when cut yield a higher proportion of the valuable meat and the quality of beef as determined by the texture, distribution of fat within the lean and thickness of flesh and fat is superior to that of cattle of inferior or scrub type. During the winter of 1911-12 The Pennsylvania State College slaughtered two steers to demonstrate before the Animal Husbandry students the causes of the difference in value between a well-finished, pure-bred Hereford steer and an ordinary plain "scrub" steer that carried about the usual amount of fat found upon cattle slaughtered in smaller towns and villages in the State. After slaughtering, the carcasses of each were valued according to the wholesale price of beef on the South Water Street market of Chicago, on January 20, 1912.

The results of this killing test are presented in order to show just where the pure-bred was superior to the "scrub." Both of the steers were given their usual allowance of water on the day they were slaughtered, hence the dressing percentage is not as high as usual from cattle that are prepared for slaughter by withholding feed and water for 24 hours before they are sent to the shambles. Another influence tending to reduce the dressing percentage was that the cattle were delivered to the slaughter house without excitement or worry.

RESULTS SECURED FROM SLAUGHTER TESTS

	Hereford.	Scrub.
Live weight,	1,420 lbs.	800 lbs.
Value per cwt.,	$8 00	$5 00
Dressed weight:		
Forequarters,	441.0 lbs.	219.0 lbs.
Hindquarters,	437.0 "	191.0 "
Total,	878 "	410 "
Weight of hide,	91 "	49 "
Loose fat,	63 "	35 "
Per cent. of carcass to live weight,	61.8%	50.2%
Per cent. of hide to live weight,	6.4%	6.1%
Per cent. of loose fat to live weight,	4.4%	4.3%

Fig. 16. A CHAMPION ANGUS STEER.

This steer was champion of the International Livestock Exposition in 1911, and was generally regarded as the best steer ever shown there. Fed by the Iowa Experiment Station.

Fig. 17. A CHAMPION SHORTHORN STEER.
Winner over all breeds at the International Livestock Exposition.

FIG. 18. STEER No. 48, SIRED BY GRADE BULL, IN "FEEDER" CONDITION.

FIG. 19. STEER NO. 48, SIRED BY GRADE BULL, AFTER HAVING BEEN FED FOR SIX MONTHS. DAILY GAIN, 1.54 LBS.

FIG. 20. STEER NO. 35, SIRED BY PURE BRED BULL, IN "FEEDER" CONDITION.

FIG. 21. STEER NO. 35, SIRED BY PURE BRED BULL, AFTER BEING FED SIX MONTHS, DAILY GAIN, 3.08 LBS. NOTICE HOW MUCH GREATER THE IMPROVEMENT IS ON THE HIGH GRADE STEER WHILE IN THE FEED LOT.

It will be seen from this data that there was a decided advantage in favor of the pure-bred, in that the carcass was much heavier in proportion to his live weight, the pure-bred steer dressing 61.8 per cent. while the "scrub" dressed 50.2 per cent. While there was a difference in value of $2.50 per cwt. on foot the difference in cost of the carcass was $2.06. This represents the higher value due to the quality of meat from well finished cattle and also the superiority of the carcass from the standpoint of the retailer, in that there is much less waste in its cutting than when compared with that from a light unfinished steer, as shown by the following exhibit:

PROPORTION AND VALUE OF VARIOUS CUTS FROM CARCASS OF PURE-BRED HEREFORD AND "SCRUB" STEERS.

	Hereford.					Scrub.				
	Weight.	Per cent. of carcass.	Value per pound.	Total value.	Per cent. value of carcass.	Weight.	Per cent. of carcass.	Value per pound.	Total value.	Per cent. value of carcass.
	lbs.	%	cts.		%	lbs.	%	cts.		%
Rib,	73	8.31	20	$14 60	13.04	32	7.71	11	$3 52	10.72
Chuck,	240	27.33	8½	20 40	18.24	126	30.73	6½	8 19	24.96
Plate, brisket and shank,	128	14.57	6¼	8 00	7.14	61	14.87	5	3 05	9.29
Forequarter,	441	50.22	9¾	43 00	38.46	219	53 41	6¾	14 76	44.98
Loin,	186	21.18	23½	43 71	39.09	71	17.31	12⅞	9 05	27.58
Round of rump, and shank,	251	28.58	10	25 10	22.43	120	29.26	7½	9 00	27.43
Hindquarter,	437	49 77	15⅞	68 81	61.54	191	46 58	9⅜	18 05	55.01
Total carcass,	878	100	12¾	$111 81	100	410	100	8	$32 81	100

The results secured from this carcass test indicate very clearly that beef cattle properly finished are more valuable than "scrubs," first, because their carcasses yield a higher proportion of the valuable cuts of beef such as rib and loin; and second, because their meat is more valuable per pound. This increased value per pound was due to the fact that the cuts were thicker, more attractive in color, better in their covering of fat, better in their marbling and contained a smaller proportion of bone to lean meat. The rib of the Herefords steer weighed 73 pounds and was worth 20c. per pound, giving it a total value of $14.60 or 8.31 per cent. of the weight of the carcass and 13.04 per cent. of its value, while that of the "scrub" weighed 32 pounds, was worth 11c. per pound, giving it a total value of $3.52 or 7.71 per cent. of the weight of the carcass and only 10.72 per cent. of its value. Thus it will be seen that the beef steer had a decided advantage over the "scrub," in that the rib weighed 41 pounds heavier, represented 1.6 per cent. more of the carcass, was more valuable to the extent of 9c. per pound or a total of $11.08. When the cheaper cuts of the forequarter of the steer are considered, it will be seen that those from the pure-bred were much heavier than those from the "scrub," but not so heavy in proportion to the total weight of the carcass. Although the difference in value per pound of the rib was 9c., it was only 2c. for the chuck and 1¼c. for the plate and brisket. The forequarter of the Hereford represented 50.22 per cent. of the total weight of the carcass and 38.46 per cent. of its value, while that of the scrub represented 53.41 per cent. of the weight and 44.98 per cent. of the value, the difference in value per pound being 3c. in favor of the well-bred and well fed steer. This indicates that breeders of beef cattle have reduced the weight of the forequarters, increased the proportion of high-priced meat, reduced that of the cheaper cuts, and increased the value of the meat.

The forequarters of the Hereford steer were worth $43.00 as compared with a total value of $32.81 for the entire carcass of the scrub.

When it comes to a consideration of the relative value of the hindquarters from the pure-bred and scrub steers, the advantage is in every way in favor of the animal that is bred for the purpose of making beef. The loin from the Hereford weighed 186 pounds, which was 21.16 per cent. of weight of the whole carcass, was valued at 23½c. per pound, or a total of $43.71 or 39.09 per cent. of the entire value of the carcass. That from the scrub weighed 71 pounds or 17.31 per cent. of the weight of the carcass and was valued at 12¾c. per pound or $9.05 which was 27.58 per cent. of the entire value. The difference in weight of loin was 115 pounds, of percentage weight of 3.87 per cent. in value was 10¾c. per pound, $34.66 in percentage value 11.41 per cent. of the entire carcass. It may also be noticed that the value of a No. 1 loin from a typical beef animal in best condition for the block is practically equal in value to the entire forequarter, and that the loin and rib represented more than one-half

of the value of the steer, but less than one-third of its weight. While the difference in the value of rib and round (including rump and shank) was $18.61 in the carcass of the pure-bred steer, the difference in value of same cuts was only five cents as compared with that from the scrub. This shows that the improvement made by a combination of breeding and feeding is one of increased percentage of the most valuable cuts as compared with the cheaper cuts in the hindquarter, also associated with a greater difference in value per pound in favor of the better loins.

The value of the entire carcass of the pure-bred steer was 12¾c. per pound and that of the "scrub" 8c. per pound when based upon wholesale prices of various cuts, a difference of 4¾c. as compared with a difference of 2½c. on hoof and $2.06 in cost of beef without allowing for hide and offal. The value of the Hereford steer was, on foot, $113.60 at $8.00 per hundred and of the carcass $111.81 at 12¾c. per pound, leaving a difference of $1.79 to be made up by the value of the hide, internal fat, internal organs and offal. The value of the scrub was $40 on foot at 5c. per pound, leaving a difference of $7.19 to be made up by hide and other by-products. This slaughter and carcass test indicates that the steer bred and fed for beef is more profitable from the standpoint of the producer, feeder, slaughter and retail dealer than the "scrub." It is equally true that the demand for beef of better quality and finish is also greater from the consumers which justifies the statement that breeding and feeding for a purpose is more satisfactory from every standpoint than the production of cattle simply as animals that are useful in turning coarse forage into manure without any further profit to the farmer.

CHAPTER IX

BABY BEEF

Baby beef is a term used to distinguish prime yearlings weighing from 900 to 1200 pounds at 12 to 20 months of age from more mature cattle in highest market condition. In order to classify as baby beef, calves must possess the accepted beef type and form, have an abundance of quality and be fed from weaning to market on rations that will produce maximum gains and a high degree of finish. It is impossible to produce prime yearlings from plainly bred or poorly fed calves. When the farmers of Pennsylvania begin to maintain low-set, blocky, thick-fleshed herds of beef cows, the production of baby beef may be considered as a profitable method of converting farm products into beef. Until that time, the feeder who may desire to enter into this method of finishing cattle must depend upon securing his calves from the Western markets at Kansas City, Missouri; Omaha, Nebraska; or Fort Worth, Texas, which has many objections.

Under prevailing conditions in the East, the best method of starting into the production of baby beef would be to obtain one or two carloads of heifer calves weighing from 400 to 500 pounds and showing every evidence of beef breeding in their ancestry. They should have broad, short heads; short, thick necks; straight, wide backs; deep, compact bodies and short legs. These characteristics should be associated with quality, smoothness and symmetry. Such heifers can best be purchased on the Kansas City market during the months of September and October. When they arrive after their long shipment, they should be turned into good pasture and be taught to eat grain immediately. After each individual has learned this lesson, the amount should be regulated in such manner as to keep them in good, strong, vigorous condition. During the first winter, a very cheap ration may be made from 10 to 15 pounds of corn silage per head daily and all of the hay they will eat, preferably alfalfa or clover for roughage and a grain ration of 8 parts of shelled corn or corn and cob meal mixed with 1 part linseed or cottonseed meal fed at the rate of 4 to 5 pounds daily. The following summer, they should be furnished with good pasture, without grain, but with an abundance of water and shade. During the second winter the ration may be

similar to those used the preceding year, except that the amount of silage should be increased to 20 to 30 pounds per head daily. Corn fodder may be used to replace silage, though the silage is better in every way. During the second summer they should be grazed without grain.

About the middle of June, during the second summer, breeding operations should begin and continue until the first of September. This will insure a crop of calves of similar age and at a time when they may be cared for with the least possible attention. The bred heifers may be fed during the third and succeeding winters as during the second, and will produce their calves during the third summer. The calves should be allowed to suckle their dams throughout the grazing season and taught to eat grain before weaning. In this way, there will be no shrinkage at weaning time, the "calf bloom" will be preserved which is essential to the production of yearling beef. All bull calves should be castrated before they are three months of age in order that both steers and heifers may be fed together. All calves should either be dehorned with caustic potash as soon as the horns can be discovered or at weaning time by means of dehorning clippers. After weaning, the feeding should be simliar to that given under the title, "Finishing Yearling Steers."

The advantages of this method are that the heifers will have reached a stage of maturity that will insure the proper development of their calves without injury to themselves, they will be carried through the winter "dry," the calves will need to be wintered through only one season, they will be grazing when the other work of the farm is most urgent and will reach market at a time when the demand for finished cattle of light weight is the most urgent. Any cows that fail to breed will be fat enough to dispose of as beef during the spring of the year, when they are always in demand. The disadvantages are that it requires a large investment through a series of years before there is any return from the finished yearlings. There is no income from the milk of the herd. In order to prevent scouring on the part of calves it is necessary to visit the pastures and draw a portion of the milk from the cows which give a heavy flow, which may be a serious task when pastures are located at some distance from farm buildings.

In order to secure a quicker return, mature breeding females may be purchased, though there is always the uncertainty of the time of calving, which results in an uneven lot the first season and the danger of introducing contagious abortion and other diseases into the herd. Under the conditions prevailing on a great many farms it may be advisable to raise the calves on skim milk, in which case, they should drop in the fall rather than the spring. This will insure a higher price for butter fat, and the labor in milking and caring for the cows will come at a season of the year when growing crops do not interfere. The cows will be dry during fly time and will need

practically no attention during the summer. While skim milk calves are as a rule not quite so well developed at a given age as are calves which are nursed, a properly fed skim milk calf is not of necessity a stunted individual.

SKIM MILK CALVES

The earlier a calf is removed from its mother, the greater is the ease with which it may be taught to drink from a pail. When the cow's udder is not in good condition, the calf should be allowed to remain until it becomes normal; otherwise, it should be taken away when two or three days old. It is essential that it should secure the first milk from the mother, which contains a large amount of colostrum that serves to discharge the foetal matter from its digestive tract. Otherwise, constipation and indigestion are encountered at the beginning of the life of the calf, which may cause a failure of proper development throughout its entire existence. During the first week the beef calf to be raised on skim milk should be given whole milk at the rate of 10 or 12 pounds per day in three feeds. At the end of the first week a gradual change should be made by substituting one quart or two pounds of whole milk for an equal amount of skim milk continuing. By the end of the second week, the change will be complete. The amount of skim milk may be increased as the calf becomes older to 16 or 18 pounds per day by the end of the first six weeks, which should be the maximum amount fed.

It is essential that calves be fed individually from clean pails at a regular time each day, in order to avoid indigestion or scouring. The milk should be sweet—preferably taken directly from a separator and fed at the temperature of the body. Care should be used that the temperature is never below 99 degress or above 100 degrees at the time it is fed to the calf. In extreme weather, milk directly from the separator may need to be warmed before feeding. If in addition to giving accurate attention to the amount, temperature and sweetness of the milk and to the cleanliness of pails, the feeder will provide well-lighted, well-ventilated and clean pens for skim milk calves, there need be no "pot-bellied" or stunted calves due to the removal of butter fat from the milk.

The calf will begin to consume other feed and water when 3 to 4 weeks of age. At this time, a mixture of corn meal, ground oats and bran will be both palatable and nutritious and should be fed immediately after the skim milk is consumed. When it is accustomed to eating grain the ration may be changed to shelled corn or shelled corn and whole oats, fed in such quantity that it will be consumed in 10 to 15 minutes, without waste. At the same age, the calf will begin to need some roughage. Bright, well-cured mixed hay, free from mould and dust is as satisfactory as any and should be fed in sufficiently small quantities that there will be no waste at any

time. The feeding of skim milk should be continued for at least six months. When a change is made from milk to grain rations there should be an addition of feeds rich in protein to the shelled corn that has been used until this time.

FINISHING YEARLING BEEF

Whether the calf has been raised by hand or allowed to suckle the cow, there should have been a continuous rapid development without interruption until it is placed in the feed lot for finishing purposes. When this time arrives, the feeder should use every effort to force his calves to the limit without causing them to get "off feed." For winter feeding roughage should consist of corn silage fed at the rate of 10 pounds and clover or alfalfa hay at the rate of 4 to 5 pounds per head daily. In connection with this, a grain ration made up of 6 parts of shelled corn to one part of cottonseed meal will result in cheap and rapid gains. The grain ration should be fed according to the appetite of the animals, which will result in a daily consumption of approximately two pounds for each 100 pounds live weight. When calves are dropped in the spring, they should be ready for market about the first of August the following year. When dropped in the fall, they should be ready during the last half of November, provided that they are crowded from birth to market. Fall calves should be turned out on pasture early in the spring and allowed access to hay so long as they will eat it. They should be fed all of the grain they will consume, mixed in the proportion of 8 parts corn to 1 of cottonseed or linseed meal. The only difference between the feeding of fall and spring calves is in the kind of roughage and the proportion of nitrogenous concentrates to corn. They should be fed all the grain they will consume, in order that they may become fat enough to classify as prime cattle when marketed.

The essentials for profitable production of yearling beef are good breeding as indicated by the blocky, early-maturing type; good quality, indicated by an absence of coarseness; and proper methods of feeding. It is a business especially adapted to farms on which cattle are both produced and finished, as it is almost impossible to buy calves suitable to be used for this purpose. The chief mistakes made in handling this class of cattle are in purchasing calves that will grow rather than fatten, feeding such rations as will not produce maximum gains or marketing them before they are made fat enough. When properly finished, steers weighing 1,000 to 1,100 pounds will sell equally as high as the heavier cattle in equal condition.

It is essential in the feeding of "Baby Beef" that calves of superior quality, type, breeding and condition be selected for the feed lot. They must have been bred for early maturity in order that they may

both grow and fatten at the same time. They will require a larger proportion of grain to roughage than older cattle, and with this grain it is essential to combine a liberal proportion of feeds rich in protein in order to provide for growth, stimulate the appetite, improve digestion, insure an even distribution of fat over the carcass and secure a degree of condition that will result in a high dressing percentage. So long as the Pennsylvania feeder depends upon buying feeders on the central markets rather than producing them, it is doubtful whether or not the production of baby beef will prove profitable within the State. In the first place, calves of a type suitable for full feeding are not generally produced east of the Missouri River in sufficient large numbers to supply local demands, hence the Eastern feeder must depend upon the Missouri River markets for his supplies. The calves will not stand a long shipment as well as older cattle, hence there is a greater risk from accident and disease, and a longer period of time is required to get them started. In the second place there are so few prime yearlings sent to Eastern markets that the buyers do not have orders for this particular grade of beef, which causes it to sell at a relatively lower price as compared with heavy carcasses that are equally well fleshed than would be the case in Central Western markets where there is a considerable number of baby beeves coming to the shambles at all seasons of the year.

The feeder who hopes to be able to produce this class of cattle in Pennsylvania must first be a breeder of beef cattle of such type and quality that the value of the calf at weaning time will be sufficient to offset the cost of maintaining a cow throughout the year. This will necessitate an abundance of grazing land stocked in such manner that the cows will not only have sufficient feed for maintenance but also to furnish a good supply of milk throughout the summer to develop their calves properly. The calves should be dropped early in the spring, taught to eat grain before weaning and put on a full feed of grain in the fall. This full feeding should continue for eight or nine months when the calves will weigh from 1,000 to 1,200 pounds each and be fat enough to find a market where the best grades of beef are consumed. This method has two advantages over any other, in that the calves can be marketed at an age which requires only one period of winter feeding, and heifers can be fed out equally as well as steers without meeting so great a discrimination in price as they would at an older age. All of the available grazing land can be used for breeding stock and young calves, as the yearlings will be sold from dry lots rather than pasture.

A considerable amount of experimental work has been done in regard to the relative advantages in feeding calves, yearlings and two-year-olds at the Kansas, South Dakota, Missouri, Iowa, Illinois and Indiana experiment stations. As these experiments have been based entirely upon the finishing period or, in other words, from the standpoint of the cattle feeder rather than the producer, the results indi-

cate that under present conditions it is more profitable to feed two year-old cattle rather than calves. This conclusion is based upon the difficulty of securing calves of the type, breeding and quality necessary for fattening at an arly age, the greater margin between buying and selling prices, the shorter feeding period, more rapid gains, greater production of pork from the undigested grain in the droppings, smaller proportion of grain to roughage and broader demand for finished heavy steers.

As the results secured at the Purdue Experiment Station cover a greater period of time than those from any other station, the following tables and comments thereon are given in full.*

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*Bulletin 148, Steer Feeding.

TABLE 1—SHOWING THE INITIAL VALUES AND WEIGHTS, LENGTH OF FEEDING PERIOD, DAILY GAIN, FEED CONSUMED, COST OF FEEDS AND FEED CONSUMED PER POUND OF GRAIN BY CALVES, YEARLINGS AND TWO-YEAR-OLDS.

	1906-7.			1907-8.			1908-9.		
	Calves.	Yearlings.	Two-year-olds.	Calves.	Yearlings.	Two-year-olds.	Calves.	Yearlings.	Two-year-olds.
Number of cattle,	20	10	10	20	10	10	20	10	10
Initial value per cent.,	$4 50	$4 15	$4 25	$4 50	$4 15	$4 00	$4 75	$4 40	$4 55
Average initial weight,	505.4 lbs.	922 lbs.	1,010.8 lbs.	530.8 lbs.	853.6 lbs.	1,123.5 lbs.	457.7 lbs.	684.6 lbs.	966 lbs.
Average initial value per head,	$22 74	$38 26	$42 35	$23 88	$35 42	$44 94	$21 74	$30 12	$43 96
Length of feeding period,	9 mos.	6 mos.	6 mos.	9 mos.	7 mos.	6 mos.	9 mos.	7 mos.	6 mos.
Average daily gain per head,	1.93 lbs.	2.38 lbs.	2.57 lbs.	1.82 lbs.	2.06 lbs.	2.05 lbs.	1.93 lbs.	2.24 lbs.	2.27 lbs.
Total feed consumed per head:									
Shelled corn,	3,041 lbs	2,783 lbs.	3,000 lbs.	3,010 lbs.	3,286 lbs.	3,423.3 lbs.	3,140.2 lbs.	3,080 lbs.	3,128 lbs.
Cotton-seed meal,	477.2 "	498.7 "	533.3 "	413.6 "	462.3 "	486 "	479.5 "	535.8 "	543.4 "
Clover hay,	870 "	644.6 "	708.4 "	844 "	783.5 "	812.3 "	1,505.3 "	1,501.9 "	1,707.8 "
Corn silage,	1,800.26 "	2,701.5 "	2,702 "	2,100 "	2,996 "	2,699 "			
Cost of feeds per head:									
At market price when fed,	$36 40	$32 49	$34 73	$42 73	$44 74	$44 56	$47 74	$46 32	$47 23
At uniform market price,	39 56	37 78	40 46	38 65	42 68	43 99	40 76	41 90	42 35
Feed per pound gain:									
Shelled corn,	5.81 lbs.	6.49 lbs.	6.47 lbs.	6.10 lbs.	7.58 lbs.	7.15 lbs.	6.01 lbs.	6.53 lbs	7.63 lbs.
Cotton-seed meal,	.91 "	1.16 "	1.15 "	.84 "	1.06 "	1.02 "	.91 "	1.13 "	1.32 "
Clover hay,	1.06 "	1.50 "	1.52 "	1.71 "	1.80 "	1.69 "	2.88 "	3.18 "	4.16 "
Corn silage,	3.44 "	6.28 "	5.82 "	4.26 "	6.91 "	5.64 "			
Average final weight,	1,028.8 "	1,351.6 "	1,474.5 "	1,024 "	1,287 "	1,602.1 "	979.6 "	1,156 "	1,375.6 "

TABLE 2—SHOWING SUMMARY OF THREE YEARS WORK ON THE INFLUENCE OF AGE ON THE ECONOMY AND PROFIT OF FATTENING STEERS.

	Calves.	Yearlings.	Two-year-olds.
Initial value per cwt.,	$4 58	$4 23	$4 26
Average initial weight,	437.9 lbs.	820 lbs.	1,033.4 lbs.
Average initial value per head,	$22 80	$34 68	$44 02
Average length of feeding period,	270 days	200 days	180 days
Average daily gain per head,	1.89 lbs.	2.23 lbs.	2.50 lbs.
Average total feed consumed per head:			
Shelled corn,	3,033.7 lbs	3,049 lbs.	3,183.7 lbs.
Cotton-seed meal,	456.8 "	498.9 "	520.9 "
Clover hay (1st two years),	857 "	714 "	760.3 "
Clover hay (3d year),	1,505.3 "	1,501.9 "	1,707.8 "
Corn silage (1st and 2d year),	1,950 "	2,848.7 "	2,700 "
Average cost of feeds per head:			
At market price for feeds when fed,	$42 29	$41 18	$42 17
At uniform price for feeds,*	39 66	40 48	42 26
Average cost per 100 lbs. gain			
At market price for feeds when fed,	8 25	9 25	9 35
At uniform price for feeds,*	7.74	9 09	9 37
Average final weight,	1,010.8 lbs	1,265 lbs.	1,484 lbs.
Average total gain per head,	512.9 "	445 "	450.6 "
Average necessary selling values per cwt.:			
At market price for feeds when fed,	$6 44	$6 60	$5 80
At uniform price for feeds,*	6 18	5 94	5 81
Average necessary margin in feeding,*	1 60	1 71	1 55
Average margin secured on stationary market,*	2 02	2 22	2 09
Average selling value per cwt.:			
On actual market,	7 15	6 63	6 35
On stationary market,	6 60	6 45	6 35
Average value per head:			
On actual market,	72 27	83 86	94 23
On stationary market,	66 71	81 59	94 22
Average profit per head:			
On actual market value per cwt.,†	7 18	8 00	8 04
On stationary market,	4 25	6 43	7 95

*Based upon the following prices:

Shelled corn, ...@ 50 cents per bushel
Cotton-seed meal, ...@ $28.00 per ton
Clover hay, ...@ $ 8.00 per ton
Corn silage, ...@ $ 2.50 per ton

†At actual prices of feeds when fed.

The calves used in each test were of the best type and breeding that it was possible to obtain, as it is not practical to try to produce prime yearling beef from inferior calves. The yearlings and two-year-olds were selected in such manner that they would be comparable with the calves in capacity and condition at the beginning of each test, in order that these two factors should not influence the results. They were not, however, of quite so good type, as illustrated by the initial and final values shown in Tables I and II. At the close of each test, the calves were sold at the extreme top price paid for cattle of their weight on the Chicago market, while the two-year-olds and yearlings secured this distinction only once in the three trials. In the other two trials, they sold from 15 to 20 cents per hun-

dred below the top, due to their being deficient in quality and type, though in each instance they were as fat as the calves when marketed.

Table I is given in order that a full report of the three trials may be examined. The experiment was repeated in order that conditions which could not be brought under entire control might be reduced to a minimum. This table shows that in each of the three years, the calves were valued at a higher price per hundred than the two-year-olds, and the two-year-olds higher than the yearlings. The rate of gain varied directly with the age of the cattle in each of the three tests. The amount of feed required to produce a pound of gain, with one exception, the yearlings in 1907-8, increased with the age of the cattle. In each year the time required to make the calves fat was greater than with the older animals. This is on account of the younger animals having to devote a much larger proportion of their feed to growth, while the older animals had nearly reached their limit in growth, hence could devote their feed largely to maintenance and fat production.

Table II shows that the average valuation of the calves at the beginning of the test was 32 cents per hundred higher than that of the two-year-olds, and 35 cents higher than that of the yearlings. Their average weight was 535.5 pounds less than that of the two-year-olds, or not quite one-half as great, and 322 pounds less than that of the yearlings. The calves required 90 days and the yearlings 20 days longer feeding period than the two-year-olds, to make them prime. The average daily gain of the calves was .61 pound per head less than that of the two-year-olds and .34 pound less than that of the yearlings.

The average of the three trials shows that the total amount of concentrates (shelled corn and cottonseed meal) required to finish calves was 3520.5 pounds per head; yearlings, 3547.9 pounds and two-year-olds, 3704.6 pounds. On account of the inability to secure a sufficient amount of silage for feeding during the third year, a direct comparison cannot be made in the average amount of roughage consumed. By reducing all to a dry matter basis, it will be found that the average amount of dry matter consumed in roughage by calves was approximately 1,745 pounds; by yearlings, 2,015 pounds and by two-year-olds 2,041 pounds, showing that the older cattle consumed a greater amount of roughage as well as concentrates and that the proportion of roughage to concentrate was greater.

With uniform prices for feeds, the table shows that it cost 82 cents less to fatten a calf than a yearling and $2.60 less than a two-year-old. This difference was so little that the feeder who intends to fatten calves, yearlings or two-year-olds might consider that it will

take an equal amount of feed in either instance. While the initial weight of the calves was much less than that of the older cattle, it was necessary to secure an additional gain of 60 to 65 pounds per head in order to make them equally fat as the yearlings or two-year-olds at the time of marketing. The gains on calves amounted to 103 per cent., on yearlings 54 per cent. and on two-year-olds 43.6 per cent. on their initial live weight.

There are four factors—the initial cost per hundred, the cost of gains, the initial weight, and the amount of gain required in fattening, which control the margin necessary to break even in finishing cattle. In these experiments, the initial weight and the gains necessary for finishing the two-year-olds had a greater influence in reducing the necessary margin than the initial cost per hundred and the cheaper gains made by the calves. With yearlings, the difference in the initial weight and in gains required for finishing as compared with the calves, was not great enough to overcome the advantage due to the cost per hundred and the decreased cost of gains on calves.

The average selling value under actual market conditions during the three years in which these cattle were fed, decreased with the increased age of the cattle. This was due to the fact that the two-year-olds were marketed in May, each year, the yearlings in May, the first, and in June, the two following years, while the calves were marketed in August each year. In 1907 there was an improvement of $1.00 per hundred in the price of fat cattle from May until August when the calves were marketed. In 1908 there was an improvement of $1.00 per hundred from May to June, followed by a decline of 50 cents from June to August. In 1909 there was an improvement of 10 cents from May to June and a further improvement of 45 cents from June to August. Owing to the difference in market conditions when the various lots of cattle were sold the selling value on a stationary market is given. While this does not change the relative order of the various ages, it reduces the difference between the selling value of the calves and the two-year-olds from 80 cents to 25 cents per hundred, and between that of the calves and yearlings from 52 cents to 15 cents per hundred, which was due to the superior quality and type of the calves as compared with the yearlings and two-year-olds. Quality, breeding and type being the same, calves, yearlings and two-year-olds will sell at the same price per hundred, if they are made equally fat.

The same conditions which affected the value of the cattle make the profits from feeding misleading when based upon the market prices of feeds and cattle, both of which varied on acount of the yearlings and calves being marketed later than the two-year-olds. When all feeds are charged at a uniform price and the market values of the cattle based upon a stationary market, the profits resulting increase with the age of the cattle. In addition to the profits reported, it should be considered that there was a large amount of manure ac-

cumulated from feeding through so great a length of time and that there was a further profit from hogs which were utilized to prevent waste in the feed lots. The pork produced from each bushel of corn fed to calves amounted to approximately one pound; to yearlings, 1.85 pound; and to two-year-olds, 2.5 pounds, which would tend to make the difference in profit from feedng even more marked than where the profit on cattle alone is considered.

GENERAL RESULTS

The results of this work justify the following conclusions:

1. The initial cost per hundred of calves is greater than that of older cattle.

2. The length of time necessary for finishing steers decreases with increased age of the cattle.

3. The rate of gain and the cost of gain increases with the increased age of the cattle.

4. The proportion of roughage to concentrates consumed increases with the increased age of the cattle.

5. The amount of gain necessary in finishing cattle of equal condition decreases as their age increases.

6 The difference in total quantity of feed necessary for finishing cattle of different ages and fed to the same marketable finish is negligible.

7. The average margin required between buying and selling prices to prevent loss was $1.60 per hundred on calves, $1.71 on yearlings and $1.55 on two-year-olds; the margins secured on a stationary market were $2.02 on calves, $2.22 on yearlings and $2.09 on two-year-olds, resulting in a profit of 42 cents per hundred on calves, 51 cents on yearlings and 54 cents on two-year-olds.

8. The increase in liveweight necessary to make calves prime was 103 per cent.; yearlings, 54 per cent. and two-year-olds, 43.6 per cent. of their initial weights at the beginning of the feeding period.

9. At a uniform price for feeds, the difference in cost of gains between calves and yearlings was $1.35; between yearlings and two-year-olds, 28 cents per hundred pounds.

10. The experienced farmer who *feeds* cattle should handle older cattle in preference to calves, while the farmer who *produces* and *finishes* his own cattle may find calves preferable.

From Bulletin 90 of the Missouri Station, based upon the feeding of 300 cattle of various ages on heavy grain rations in connection with bluegrass pasture, the following conclusions are taken:

"1. Two-year-old cattle make larger average daily gains than yearlings.

"2. Two-year-old cattle consumed from 13 per cent. to 22 per cent. more grain per day and per head than do yearlings.

"3. Two-year-old cattle in this experiment consumed more grain per day per thousand pounds live weight than yearlings.

"4. Yearlings require less grain for each pound of gain than do two or three-year-old cattle. Other things being equal, the younger the animal, the less grain is required to make a pound of gain. The condition of the animal at the beginning of the feeding period is an important factor, and may to a large extent counteract the influence of age in determining cheaper gains.

"5. In these investigations, the fattening of two and three-year-old cattle has been generally more profitable than fattening yearlings. The chief reasons are:

"(a) The margin between the buying and selling price is less in the case of yearlings than in the case of two or three-year-old cattle. The older cattle fatten in a shorter period.

"(b) It is not generally advisable to try to finish the cheaper grades of yearlings. In our investigations, the quality of the yearling has generally been higher than of older cattle. In spite of this fact, the financial results have seemed to favor the feeding of older cattle."

It will, from the data presented, be noticed that the results indicate clearly that the fattening of older cattle is more profitable whether the feeding period is in winter or in summer.

At the Michigan Experiment Station* an experiment covering a period of three years, in which the object was to determine the relative profits from two methods of handling the ordinary grade beef herd:

Following one method, the calves were nursed by their dams, also receiving supplementary feed and after weaning were finished for market as baby beeves at eighteen months of age.

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*Bulletin 261, Michigan Station.

By the other method the calves were weaned at birth and reared on skim milk with supplementary feeds and finished for market at eighteen months of age. The results are summarized in the following way:

SUMMARY OF RESULTS FOR THREE YEARS—HERD I

Average cost of feed per year for cows suckling calves.....	$32.32
Average cost of feed, additional to being suckled by dams, consumed by baby beeves from birth to close of feeding period, 18 months of age	34.65
Average cost per head of baby beeves	66.97
Average weight per head	995 lbs.
Average cost of production per cwt.	$6.73

SUMMARY OF RESULTS FOR THREE YEARS—HERD II

Average cost of feed consumed by baby beeves raised by skim milk method	$50.77
Average weight per head	966 lbs.
Average cost of production per cwt.	$5.24
Average value of butter and skim milk produced per year by cows, dams of skim-milk fed baby beeves	61.12
Average cost of feed per head per year	33.84
Average profit per head over cost of feed	$27.28

The results indicate that the cost of producing beef was $1.49 per cwt. in favor of the skim milk lot in addition to a profit of $27.28 per head from the milking of the cows. The suckled calves weighed only 29 pounds per head more than those raised on skim milk, at 18 months of age. The quality of the baby beef produced by the two methods was practically the same.

The author states that the cost of production was undoubtedly higher than it would have been under farm conditions, but is representative of the comparative method of feeding. The fact that calves were dropped in the fall of the year gives a decided advantage to the skim milk calves as the most profitable method of producing baby beef when cows are suckled necessitates spring calves. No account was taken of the difference in the amount of labor in the two methods of feeding. The average amount of grain fed to cows suckling calves was greater than that fed to cows that were milked, which

is contrary to the general practice in producing beef when the breeding cows are used largely to consume roughage and are rarely ever fed grain. At the Pennsylvania Experiment Station beef breeding cows were maintained throughout the winter of 1911-12 on a ration consisting of 50 pounds of corn silage and one pound of cottonseed meal, during which period there was a marked improvement in weight and condition without further grain feed. Allowing $3.00 per ton for silage, $1.50 per cwt. for cottonseed meal and $6 per head for a season's grazing, the cost of maintaining the beef breeding cows throughout the year will be $22.20 per head. This emphasizes the fact that the profits in producing beef cattle depend largely upon the cost of maintaining breeding herds, which means that they must be fed largely on roughage instead of grain in order that the value of their calves will be greater than the cost of maintaining the dams.

SELECTION OF FEEDING STEERS

The ideal feeder is a steer that has made exceedingly rapid growth and deposited a considerable amount of fat on his body while being grown on the cheap feeds of the farm, such as grass, silage and leguminous forage crops. He should also be of such type and conformation that he will make rapid gains when placed in the feed lot and and fed on concentrated feeds, such as corn and cottonseed meal. He should have sufficient constitution to stand a heavy feeding period of from four to six months and at the close be finished into the sort of a bullock that will demand a high price on the market because of his ability to yield a high percentage of carcass to live weight, the carcass being of such shape as to yield a large proportion of the most valuable cuts of beef, the rib and loin as compared with cheaper cuts, the neck, plate, brisket and shanks. The carcass should be covered with a smooth even layer of fat, both inside and outside and when cut should show a thickness of bright red muscle of the finest fibre, beautifully marbled with fat throughout. In order to secure feeders of this type, it is necessary that they be sired by pure-bred beef bulls of excellent individuality and out of cows of approved beef type.

Looking at a feeder in detail, he should possess a broad, short, clearly-cut head with eyes that denote a quiet temperament and with strong jaw, large mouth and nostrils denoting feeding capacity. There should be an entire absence of either coarseness or delicacy and no indication of femininity or masculinity. With such a head is correlated rapid and economical gains and typical beef form, hence it is of very great importance in selecting steers for the feed lot. A long, narrow head indicates delicacy, poor feeding qualities and is usually associated with an undesirable type and restless disposition. The neck should be short and thick. As this is one of the cheaper portions of the carcass, excessive length is objectionable. While thickness gives greater weight, it has been observed that steers with thick necks usually have a heavy development of muscle in the valu-

able parts of the carcass, and those with thin necks are usually light in their covering. The shoulder should be smooth and its width proportionate with the remainder of the body. A coarse, heavy shoulder requires a long feeding period in producing a smooth finished steer.

The body should be short, deep and wide in order to insure a heavily muscled back and loin; the depth and width in front giving room for the development of vital organs and in the hind flanks to denote large capacity for the storage of bulky feeds. One of the chief advantages of feeders produced from beef breeding animals comes from their ability to consume large quantities of feed above that required for maintenance and convert it into flesh and fat. A steer that is deficient in girth at the heart, middle of paunch or hind flanks is rarely ever a satisfactory steer in the feed lot. The Nebraska Station has determined by the measurement of a large number of experimental steers that those with a large middle produce gains more rapidly and more economically than others deficient in this respect. It is desirable that the size of middle comes from a good spring of rib, width and depth rather than from excessive paunch.

The back should be straight, short, smoothly and heavily muscled and uniformly wide throughout in order that the finished steer may be attractive to slaughterers. The hips should be smooth and not too wide apart as compared with other parts of the body. Steers with rough, coarse hips are slow in finishing. The rump should be long, level and wide and the thighs full, deep and heavily muscled down toward the hock. The legs should be short and straight, denoting early maturity and easy feeding qualities. It is the exception when young steers showing a tendency to "legginess" fatten in a satisfactory manner. They make equally as rapid gains as the blocky, early-maturing type, but this increase is largely in the form of growth rather than fat. If aged feeders are selected, the upstanding type may fatten as rapidly as those that are more blocky, but a longer feeding period will be necessary in order to produce a smooth carcass.

Quality in feeding cattle is indicated by the condition of their skin and hair, the fineness and smoothness of bone and a general absence of coarseness throughout. A thick, fine, bright coat of hair indicates health, thrift and easy fleshing qualities. The smooth, refined steer that shows no indication of delicacy will make rapid and economical gains, finish at any age and dress out a high percentage of beef and produce a carcass of superior excellence as compared with a rough or plain individual.

While the individual steer is used to illustrate the value of type, quality and capacity in feeding cattle, it is important in fattening animals that all of those fed at one time be as nearly as possible of the same age, type, weight, condition, quality and color in order that one method of feeding will serve for the entire lot, that all will be

ready for the market at one time and that they may make a favorable impression upon cattle buyers. In this connection, it might be well to state that the purpose of the feeder should determine the class of feeders which he will purchase. Inferior cattle cannot profitably be fed so long or to so high a degree of finish as those of approved beef type. The same increase in weight will not result in as much increase in value on the plain as compared with fancy cattle. When roughage is used extensively, it is inadvisable to buy cattle in high condition, though the ideal feeder will be more useful in the same condition in utilizing such materials.

Fig 22. A FANCY SELECTED FEEDER.

This steer is hardly as good as he should be to grade as "selected" says the Illinois Experiment Station, by whose courtesy all these photographs of feeders are used. In Pennsylvania steers, with as much flesh as he has, would class as butcher steers and go to butchers in most cases.

Fig. 23. A CHOICE FEEDER.

This steer would also usually grade as a butcher steer in Pennsylvania because he carries flesh enough to sell for ordinary beef.

Fig. 24. A GOOD FEEDER.

This feeder is better than his photograph. He has breeding and some flesh and promises to make a good fat steer.

Fig. 25. A MEDIUM FEEDER.

This steer with less flesh and perhaps less quality than those shown in Figures 23 and 24 is the type generally bought in this State for finishing.

Fig. 26. A COMMON FEEDER.

A plain steer, showing lack of quality and breeding but constitution and ability to make gains. His gains are not likely to make so high a percentage of rib and loin cuts as those of the better bred steers shown in preceding photographs.

Fig. 27. INFERIOR FEEDER.

This steer shows lack of beef breeding and lack of flesh also, but he is better than many of the inferior steers fed in this State. Inferior cattle may make the man who finishes them as much money as any if they are bought low enough; but they must be bought cheap to make money in the feed-lot.

Fig. 28. A GOOD STOCK HEIFER.

The kind taken by feeders to finish or by breeders who are starting grade herds.

CHAPTER X

SUMMER FEEDING

GRAZING

Grazing cattle is a distinct art, in which to be successful, the owners should not only have a clear conception of the most profitable type and condition of an animal at the beginning of the season, but should have handled him in such a manner during the preceding winter that the gains on grass can be most rapid and most economical.

As the age of a steer increases, provided he is kept in stocker condition, the gains on grass alone will also increase. This is largely due to the fact that the mature steer does not have to utilize his food for the production of growth but only for the production of fat. It is well exemplified on the central markets by the fact that, as a rule, the four-year-old steers are sold for immediate slaughter. A large majority of the three-year-old steers find the same outlet, while the calves, yearlings and two-year-olds are usually sold to feeders who give them either another season of grazing or put them immediately on full feed of grain, in order to make them fat enough to sell for slaughtering purposes.

The character of the ration that the animal has received during the preceding winter has a marked influence upon the rate of gain. If wintered on hay alone, the gains will be much more rapid than if wintered on grain and hay. It is generally conceded by cattle feeders that steers which have received a full feed of grain during the preceding winter should be fed out in a dry lot rather than turned on pasture if they are to be marketed before the first of July, as the grass, being more palatable than the dry grain to which they have been accustomed, causes them to lose their appetite for grain during the first ten days to two weeks, during which time they will lose in weight. This requires an additional two weeks feeding to bring them up to their normal weight when turned on the grass or a loss of a month in the finishing period.

The feeding of non-leguminous plants, such as timothy, corn fodder and straw, without grain, leaves the animal in the best possible condition for making rapid gains during the summer. When fed on legumes, such as clover, alfalfa or cowpeas during the winter, the steers make much more rapid gains, but when turned on pasture they fail to make as rapid an increase in weight as those fed on non-legumes.

SILAGE

Silage that is fed during the summer to stocker or feeding steers results in much more rapid gains than where they are fed exclusively on dry feeds. However, the gains during the summer season on grass alone are much less where cattle are fed silage during the winter. If the entire year is considered, it will be found that the steers that are fed on silage during the winter and grass during the summer will weigh heavier at the close of the grazing season than similar cattle that have not been fed on silage.

There are two methods of turning out cattle on grass, either of which is fairly successful. Where the pastures are short or in very limited areas, it is much better to allow them to gain some headway in the spring before cattle are turned on them. This permits the grass to develop better, gain in substance and to eliminate some water, making much strong and richer feed than the extremely early and succulent grasses. For cattle that have been carried through the winter in very thin condition this method will prove quite satisfactory. Where cattle have been fed heartily on grain during the winter season, it is better to turn them out as soon as the ground is in condition that it will not be injured by tramping and continue the feeding of both grain and roughage in the same manner as has been practiced in the winter. In this way the steers become gradually accustomed to grass and do not have the period of shrinkage that always accompanies turning out full fed steers later in the season. Where it is necessary to keep them up in dry lots late in the season, they should be allowed to graze from one-half to three-quarters of an hour, the first few days, increasing the length of the period until the cattle become thoroughly accustomed to grass before permitting them to remain on pasture throughout the entire day.

GRAIN ON GRASS

The question of the amount of grain which should be fed to steers that are being grazed will depend entirely upon the character of the pasture and the condition of the cattle. If the pastures are rich, with an abundant growth of foliage, aged cattle especially will make exceptionally good gains during the early portion of the grazing season, without grain. If it is the intention to market them early in the year, the full feeding of grain will make them somewhat fatter,

cause them to shed off earlier and be in marketable condition in a shorter length of time than where they depend upon grass alone. With steers that have been roughed through the winter on roughage alone, the gains on grass without grain will be equally as large as where grain is fed as long as the pastures remain in good condition. As they increase in weight and become fatter, it is necessary to add grain to their grazing rations, in order that the rate of gain may be kept up to normal.

It is generally considered that a two-year-old steer, in very thin condition in the spring of the year and grazed without grain through the entire summer season, will gain 300 to 325 pounds in weight, on an average. Where grain is fed in addition, the gains may be kept up throughout the grazing season so that the steers will have gained from 400 to 500 pounds, according to the amount of grain that is fed. The kind and amount of grain should depend upon the characters of the pastures. Possibly Kentucky blue grass, through the larger section of the grazing area of the United States, is the best pasture grass that we have. Where cattle are being finished for market on this sort of pasture the grain ration should consist almost entirely of corn, supplemented during the late summer and early fall months, with a limited amount of nitrogenous concentrates, such as linseed or cottonseed meal. The amount of grain to be fed will depend entirely upon the condition of the cattle. This should be limited to an amount that will insure rapid gains without waste until the cattle arrive at that condition where they might be sold as good butcher steers on our central markets. The grain ration should be limited to 8 or 10 pounds per head daily. Where it is the intention to make them prime before sale, fit to top the markets, the grain ration should be increased from that time forward until the steers are getting all they will consume without waste. It is always advisable to supplement pastures during the periods of drought, which usually occur during July and August. The best supplementary crops are Canada field peas and oats, sorghum or green corn. These should be fed freely and liberally so long as the grass is in what is known as the resting stage. Where the growing of corn is possible in a very large way it is probably more economical to fill the silo and carry it over for summer use instead of depending upon soiling crops which require a large amount of labor and time in their feeding.

Probably the largest amount of work in comparison of different seasons of the year for fattening cattle has been done at the Missouri Experiment Station, from which the following statements are taken:

EXPERIMENTS IN SUMMER VS. WINTER FEEDING*

This Station has conducted a number of feeding experiments in summer and winter, under circumstances that make the results fairly comparable, and a summary of the outcome of these experiments will be interesting in this connection. Below is given a summary of three years results in summer feeding with two-year-old steers and five years of winter feeding with cattle of similar age, the rations being in both cases chiefly shelled corn, with some supplement like cottonseed meal or linseed meal in a number of cases in both summer and winter, and in other cases, corn alone. The roughness in winter was, in most cases, timothy hay. In a few cases, however, clover or cowpea hay was used.

Comparison of Results of Summer and Winter Feeding

	Summer.	Winter.
Time covered by experiment,	3 years	5 years
Number of steers involved,	88	105
Average number days on experiment per lot,	209.3	107
Total grain consumed,	355,334 lbs.	238,872 lbs.
Total roughness consumed,	.....	91,450
Total gain in weight,	43,612 lbs.	23,910 lbs.
Grain eaten daily per steer,	.....	21.29
Roughness eaten daily per steer,	.....	8.15
Grain required per pound of gain,	8.14	9.99
Roughness required per pound of gain,	.....	3.82
Average daily gain per steer,	2.37	2.13

The quality of the cattle used in the different experiments was essentially the same. The cattle used in the winter trials were about six months older than those used in the summer tests. In other words, the summer feeding began in the spring, when the cattle were just two years old, whereas the winter feeding experiment began in the fall, when the cattle were approximately 30 months old. This is to the disadvantage of the winter feeding, because the presumption is that the cattle being six months younger when fed in summer were making gains somewhat cheaper. It will be noted, however, that the average length of the feeding period in the winter trials was only 107 days, whereas in the summer experiments it was 210 days or practically twice as long. This means that the summer fed cattle were made much fatter, and it is fair to assume that whatever advantage they possessed in point of youth was more than offset by the additional length of the feeding preiod or by the extra amount of fat

*Missouri Bulletin No. 70, by H. J. Waters.

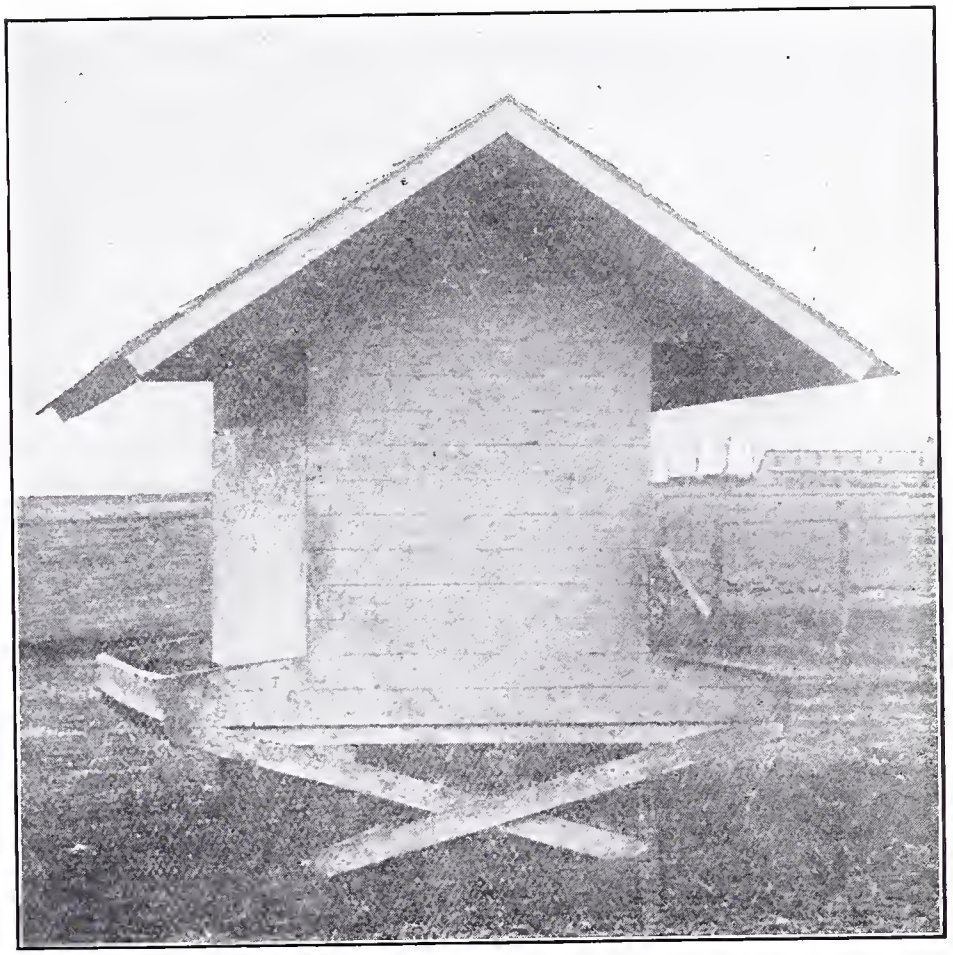

FIG. 29. SELF-FEEDER FOR CATTLE.

Self-feeder for feeding grain on grass used at the Illinois Experiment Station. Photo by courtesy of Prof. H. W. Mumford.

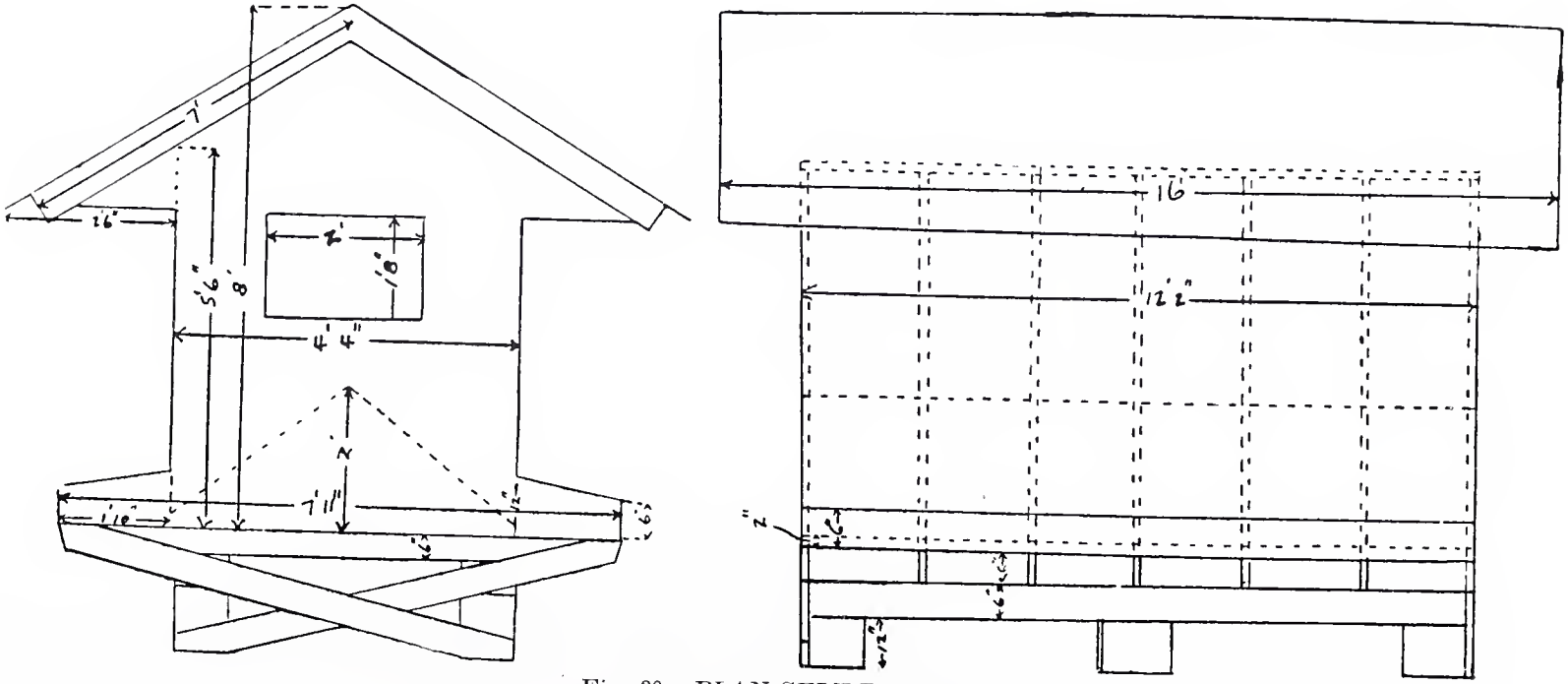

Fig. 30. PLAN SELF-FEEDER.

they were made to carry before the experiment closed. If the comparison is unfair at all, the injustice is done rather to the summer than to the winter fed cattle.

It will be interesting to note that the average daily consumption of roughness per head in winter by cattle on full feed was 8.15 pounds. This means that each steer ate per month about 245 pounds of hay. Rating this hay at $5.00 per ton, makes the monthly consumption 61 cents per head. If the hay be worth $6.00 per ton, the monthly charge for roughness would be 73 cents; at $7.00 per ton, the cost would be 88 cents per steer, whereas, with hay rated at $10.00 per ton, the charge for this portion of the steer's ration would be $1.22 per month.

The price for pasturage of steers on full feed would easily fall somewhere beteewn 61 cents and $1.22 per month. This means that the roughness consumed in winter will practically offset the cost of grass in summer. The problem is, therefore, narrowed down to a direct comparison of the grain required to produce a pound of beef under the two systems and the relative amount of labor and general expenses involved.

It will be observed that 10 pounds of grain made one pound of beef in winter as an average of all steers or that a bushel of corn (for the bulk of the grain used was shelled corn in both summer and winter) made 5.6 pounds of beef.

The average of the summer trials shows that 8.14 pounds of grain produced a pound of gain or that a bushel of corn represented 6.88 pounds of beef, a difference in favor of summer feeding of 22.7 per cent. in the grain requirement per pound of gain.

It will be noted that the steers gained more rapidly in summer than in winter, the average for winter feeding being 2.13 pounds per day, and in summer, 2.37 pounds per day.

These summaries, therefore, furnish a general answer to the objections raised by numerous writers to the tendency among our feeders toward the discarding of winter feeding and the adopting of summer feeding.

ADVANTAGES OF SUMMER OVER WINTER FEEDING

The advantages of summer over winter feeding may be very briefly summarized as follows:

First. Gains made in summer require less grain.

Second. The gains are made more rapidly, so that the animal is finished in less time.

Third. Steers may be made thick and prime on corn and grass in summer without the use of expensive supplementary feeds like cottonseed meal or linseed meal and will carry to market a lustrous coat. It is impossible, by the use of corn and such roughage as timothy or prairie hay, to bring animals within a reasonable time to anything like the degree of fatness that may be easily made with corn and grass, and they will never carry the bloom that is put on by full feeding at pasture. Presumably the green grass contains sufficient protein to give the high finish and excellent coat required of animals that bring a high price. To approximate this finish in winter feeding requires the use of a considerable quantity of expensive grain like cottonseed meal or linseed meal or the use of clover, cowpeas or alfalfa hay for roughage.

Fourth. The hog makes larger gains and shows a very much lower death rate in summer than in winter feeding.

Fifth. There is a considerable saving in labor in summer feeding over winter feeding, in view of the fact that only the grain has to be hauled, and in view of the further fact that, as a rule, the steers need to be fed but once a day—either about sunrise or near sunset. To offset this, however, labor on the average farm is scarce and much higher priced in summer than in winter. The manure is scattered by the cattle themselves, and the hauling of it out upon the ground is dispensed with. Grass is cheaper than hay, as has already been pointed out, and makes better gains. The handling of the roughage is likewise disposed of.

INFLUENCE OF WEATHER

A part of the superiority of summer over winter for fattening cattle is due to the superiority of grass over cured hay as a feed, but another part of it may be attributed to the more uniform and steady climate of summer and to the absence of the disturbance of the variable weather of winter. In other words, the weather itself affects very materially the rate and cost of gain of cattle. The ideal conditions in winter for cheap and rapid gains are clear, cold, crisp weather. The conditions most unfavorable are cloudy, wet, warm, foggy, muggy weather. The injurious effects of this damp weather are threefold:

First, exerting a depressing influence upon the animal itself to such an extent that its appetite is greatly reduced.

Second, the lots, despite any ordinary management, becomes excessively muddy, thus keeping the animal on its feet instead of making the conditions most favorable for it to lie down.

Third, affecting the palatability of the feed.

In the latitude of Missouri, the winter weather is quite variable, and this is particularly true of the season from the middle of February to the middle of April. It is particularly costly to attempt to finish cattle in this season. Fairly rapid and economical gains can be made in this variable weather on thin cattle that have been freshly put to feed, but when the steers approach the finishing period, when their appetites become dainty and when, at best, it is difficult to induce them to eat enough to make substantial and economical gains, the disturbance of the weather is particularly noticeable, and often times when cattle are almost finished, they will stand for 30 and sometimes 60 days without making scarcely any gain at all. This is quite likely to be true if the lots are muddy and if the roughness is not particularly palatable and is fed in the open, where it is drenched with rain soon after it is put in the rack.

The most favorable portion of the winter season for breeding is in the late autumn and during December and January, unless these months be wet or variable.

Many of the most successful feeders do not finish their cattle in these unfavorable parts of the winter, but utilize them for getting the cattle started or "warmed up," as they express it.

THE SEASON AS IT AFFECTS SUMMER FEEDING

The weather in summer is not likely to be so variable as in winter, although its combined influence upon vegetation and directly upon the cattle themselves is sufficient to affect very materially the results.

This influence, however, is chiefly upon the vegetation, which immediately affects the animal that is feeding upon it. Taking the extremes of rainfall for an example. In an excessively wet summer, the grass is rank, coarse and washy. Usually, this grass is very palatable, which encourages the animal to make a disproportion of its daily ration of grass rather than of grain. The grass is, furthermore, washy, tending constantly to scour the animals, so that the grain and grass they eat have less than a normal nutritive value. Later in the season, if the rains continue, the covering of grass on the ground in good pastures, becomes so dense and thick as to be attacked by a white mold, and becomes, in the parlance of the feeder "funky." Then the animals eat very little of it, and what they do eat has, apparently, little nutritive value. Moreover, it is in such a season as this that such pests as the horn fly are most numerous and most injurious. It is at the close of such a feeding season as this that cattle shrink badly in shipping and reach the market in a soft, unfinished condition, after having made unsatisfactory gains.

The other extreme is the dry season, when the growth of grass is very much restricted and when only sufficient rain occurs to keep it from becoming covered with dust and to maintain, except in July and August, a moderate growth, and when during July and August the grass cures on the pasture and is not injured by rain after being cured. Under these circumstanes, the grass is very nutritious, has no tendency, whatever, to scour the animals and is not so palatable that they will eat a disproportionate amount of it and thus neglect their grain. In our experience, in such seasons the amount of grain consumed has been very much larger than in wet seasons with succulent grass, and the rate of gain has been materially higher. Not only so, but the flesh laid on is hard, which means that it is fat, and the animals will reach a prime condition in from 40 to 60 days less time, will stand shipping far better, will make a better fill on the market, are cleaner and uniformly sell better. Likewise, in such dry season there is frequently an entire absence of flies.

Between these two extremes come all gradations and combinations of rain, heat and flies, which will affect favorably or adversely the result.

As a further illustration of the effect of the grass upon the character of the gain, attention is called to the condition of the cattle from New Mexico, Arizona and portions of California when they reach the market. These cattle, after having grazed on the cured grass, are fat enough to seriously compete with steers of even better quality which have been grazed on bluegrass in the ordinary season in the corn belt and have been fed for a short time, say 60 or 90 days, on corn.

Some of the authorities on feeding have questioned the wisdom of the change from winter to summer feeding, which has been one of the most characteristic developments in beef production in the Middle West during the last 25 years. These authorities maintain that it is more profitable, all things considered, to graze the cattle in summer and full feed in winter after the grass is gone. They base their judgment on some imperfect and very limited data and upon the very erroneous assumption that grain fed cattle on pasture, to be profitable, must show enough gain over and above what the cattle would make on grass alone to pay a profit on the grain consumed. Unless, therefore, in the judgment of these authorities, this result is accomplished, the grain has been used on the steer in summer at a loss.

They further point out the fact that the yearling steer would gain on grass alone during the six months period of summer, an average of about 45 pounds per month, and a two-year-old steer approximately 50 pounds, which at a reasonable charge for pasturage would make the gain cost from 1½ to 2 cents a pound made on grass alone,

while gains produced with a combination of grain and grass in summer cost from 5 cents to 8 cents a pound. The conclusion, therefore, is that the adding of grain to the ration in summer does not tend to cheapen the cost of gain and that cheaper gains could be made by permitting the steers to graze without grain.

It is a matter of common knowledge that the cheapest possible gains are made on grass alone. It should not be forgotten, however, that steers when grazed without grain are not ready for the market and must either be sold as grass cattle at a relatively low price or they must be sold as feeders, with sufficient margin to enable the buyer to finish them in winter, under less favorable circumstances and at a greater cost than is required to finish them in summer. Or else they must be carried through the expensive period of winter as stockers to be fed out the following summer. In other words, while grass gains are cheap gains, they are likewise low price gains and leave the animal in an unmarketable condition at the beginning of the winter, when it is in less demand than at any other time of year and must be sold at the lowest price of any season of the year. This means that the wintering of cattle and the fattening of cattle are both expensive processes, and were it not for the enhancement of the value of the steer by these processes over and above the mere selling value of the mere pounds of gain made, they would both be conducted at a loss.

The proper comparison, therefore, between summer and winter feeding is: Which method will fit a steer for market in the best way, at the lest expense and in the shortest time and land him on the market at a season when he will sell to the best advantage?

Our results as has always been pointed out show that this may be accomplished to the best advantage in summer.

While all experimental evidence seems to show that the summer feeding of cattle is more profitable than winter feeding, it should also be remembered that the relative cost of cattle in the spring of the year, suitable for feeding purposes, is much higher than in the fall. The difference in values of feeding cattle through a series of years is in favor of cattle marketed in the spring. In other words, the margin between buying and selling prices of cattle bought in the fall of the year and sold during the following spring is much greater than with cattle bought in the spring and marketed during the following fall.

Another factor that controls to a very large extent whether or not the feeder is justified in winter or in summer feeding is the acreage

of land that can be kept in permanent pastures as compared with that that is kept in the ordinary rotation on most stock farms. Where pasture land is abundant in proportion to the amount of land that is kept in grain and hay crops, summer feeding is usually justified. On the other hand, the chief object of feeding cattle in Pennsylvania is to utilize the crops that are ordinarily produced under the present system of farming. This means that there is a large amount of hay, corn stover and straw produced in proportion to the amount of grazing land that is available on most farms, which necessitates winter rather than summer feeding.

There are many sections of the State in which a large amount of waste land is now growing up in brush and is largely unfenced, which could be profitably used, either for grazing cattle or for feeding them in winter. As a rule, however, these waste and rough lands are considered of little value, hence no attention is given to the maintenance of permanent pastures. While fertilizers are used liberally in producing corn, wheat and other crops, it is the exception rather than the rule to find anyone using fertilizers on pasture land. There is a large opportunity offered in the State for the clearing of these waste patches, seeding them down to mixtures of good pasture grasses, stocking them intelligently with beef cattle and thus turn to profit a large area that is now merely an expense to its owners. To do this, however, will necessitate much more care than is usually given the pasture land in the State. They should not be stocked so heavily but that the cattle will have an abundance of feed throughout the entire year, that the increase in growth of the plants during the fall of the year will be greater than the consumption by the cattle. This will cause the pasture to go into the winter quarters well covered, so that they will hold the snow and the moisture, will prevent them from freezing so deeply, and thus they may be used much earlier in the spring of the year.

If, in connection with this, it would be possible to use lime on those soils which are sour in order that a greater percentage of legumes could be found in the pasture crops and such fertilizers as phosphoric acid and potash could be applied in liberal quantities, the yield from the lands that are usually used for pasture purposes could be increased from three to four fold. The present system throughout the greater portion of the State is to stock the pastures as heavily as possible in the spring of the year when the grass is growing at its maximum rate, keeping the entire number of livestock upon these pastures throughout the entire summer, so that in the fall of the year when the plants really shoud be storing up food for use during the following winter and spring, they are grazed very

closely, and the result is that the cattle lose in weight during the months of October and November. Many plants perish on account of freezing during the later winter months, and it is impossible to depend upon the pasture until the latter part of May or the first of June during the following year.

CHAPTER XI

SILAGE FOR FATTENING CATTLE

When silos were first used, they did not find favor among the men who were feeding beef cattle, largely because of the fact that the feed produced was considered too watery, and as in the tests that were made on the farms of the corn belt, it was used to replace shock corn in the rations. It was natural to suppose that the feeding of the whole corn plant in dry form in comparison with silage was the most logic method of comparison, though a closer study of the problem shows the fallacy of this assumption. When feeding shock corn, cattle have the opportunity of consuming the ears, leaving the larger part of the stalk and leaves to be trampled under foot as bedding. When the same amount of corn is fed from a silo, the cattle are compelled to consume as much of the stalk as they do of ears, as they have no chance of refusing the roughage without also refusing the grain. A steer will consume, under the most favorable circumstances, about 60 pounds of silage in 24 hours. This contains about 6 pounds of shelled corn. If allowed equal opportunity to consume shock corn, he will eat from 25 to 35 pounds of ears or nearly half a bushel within the same time. When a comparison of silage is made with ear corn, the steers on silage are consuming only one-third to one-fourth as much feed in concentrated form as those on shock corn. In other words, silage is essentially a roughage while shock corn is a concentrate.

In recent years, a large amount of experimental work has been carried out in Pennsylvania, Ohio, Indiana, Missouri, Iowa and Illinois in regard to the best methods of utilizing silage for fattening cattle. This work is presented at considerable length in order that the feeders of Pennsylvania may form a true opinion of its usefulness and value as a feed.

CORN SILAGE AS A ROUGHAGE IN FATTENING TWO-YEAR-OLD STEERS*

It has been found in experiments at Purdue and other stations, that corn fodder harvested or cured in the best possible manner is

*Purdue Bulletin, No. 129

not consumed without a large percentage of waste, varying from 20 to 35 per cent. The work at this Station for the last two years justifies the statements that the cattle will consume all of the silage, if not fed in excessive quantities. The other advantages that are conceded for silage are that a greater amount of feed may be stored in the same space, that it gives smoothness to the coat, keeps the animals in good condition, serves as a stimulant to the appetite, and obviates the necessity of hauling fodder or shock corn during the winter months, when covered with snow or when the fields are extremely muddy. Even with these advantages in its favor, it is necessary to demonstrate that it can be used with profit before a great number of cattle feeders will include it in their regular rations for fattening cattle.

THE VALUE OF CORN SILAGE FED WITH SHELLED CORN AND CLOVER HAY

The steers were similar in age, condition, breeding, weight and previous treatment. In the first test, they were valued at $4.25 per hundred at the beginning of the test and weighed an average of 1,010 pounds per head in the lot receiving silage, and 1,014 pounds in the lot receiving no silage; in the second test they were valued at $4.00 per hundred and weighed 1,125 pounds per head in the lot receiving silage and 1,112 pounds in the lot receiving no silage.

Table Showing Value of Corn Sialge Without Supplement in Fattening Two Year Old Steers

Date of Experiment. Length of Experiment. Ration fed.	Nov. 21, 1906-May 20, 1907—180 Days.		Nov. 17, 1907-April 15, 1908—150 Days.	
	Shelled corn, clover hay.	Shelled corn, clover hay, corn silage.	Shelled corn, clover hay.	Shelled corn, clover hay, corn silage.
Initial value per cwt.,	$4 25	$4 25	$4 00	$4 00
Initial weight, 10 steers,	10,106 lbs.	10,145 lbs.	11,215 lbs.	11,250 lbs.
Final weight, 10 steers,	13,731 "	13,481 "	14,073 "	13,961 "
Average daily gain per steer,	2.01	1.85	1.90	1.80
Total feed consumed:				
Shelled corn,	35,133 "	30,095 "	28,310 "	26,985 "
Clover hay,	14,903 "	7,180 "	14,700 "	7,415 "
Corn silage,	.....	26,935 "	.....	23,925 "
Average daily feed per steer:				
Shelled corn,	19.51 "	16.73 "	18.87 "	17.99 "
Clover hay,	8.27 "	3.98 "	9.80 "	4.94 "
Corn silage,	.....	14.96	.....	15.95
Feed per lb. gain:				
Shelled corn,	9.69 "	9.02 "	9.90 "	9.95 "
Clover hay,	4.11 "	2.15 "	5.14 "	2.72 "
Corn silage,	.....	8.08	.....	8.84
Cost of gain per cwt.:*				
Corn @ 40c. per bu.,	$8 56	$8 31	$9 13	$9 30
Corn @ 40c. per bu.,	10 29	9 80	10 89	11 07
Corn @ 50c. per bu.,	5 84	5 65	5 39	5 37
Necessary selling price:*				
Corn @ 40c. per bu.,	$5 38	$5 25	$5 03	$5 03
Actual value per cwt.,	$5 45	$5 30	$5 95	$6 00

*Based upon the following prices:

Clover hay, ... $8.00 per ton.
Corn silage, ... 2.50 per ton

This table shows that at the close of the first test the steers in the lot receiving no silage weighed 1,373 pounds per head; in the lot receiving silage 1,348 pounds. At the close of the second test the steers in the lot receiving no silage weighed 1,407 pounds and in the lot receiving silage 1,396 pounds. In both tests the rate of gain was greater in the lot fed on shelled corn and clover hay without silage than in the lot fed shelled corn and clover hay with silage. The table shows also that the total grain consumed was greater in the lot which received no silage than in the lot receiving silage. This is the result that would be expected, as it is well known that the more protein fed, the greater is the daily consumption of feed and that the grain contained in the silage may reduce the consumption of dry grain.

The grain consumed per pound of gain in the first test was 9.02 pounds in the lot receiving silage as compared with 9.69 pounds in the lot receiving no silage. In the second test it was practically equal in both lots. In determining the cost of gains it was found that during the first test they were decidedly cheaper in all lots than in the second test. This was also true in the lots used to determine the influence of age as reported in Part I. The cost of gains in the first test was in favor of the lot receiving silage: in the second, in favor of the lot receiving no silage. The necessary selling price per hundred for cattle, in order that there may be neither profit nor loss in feeding, is determined by adding their initial cost to the cost of feed and dividing by the final weight of the cattle. This gives the necessary selling price at home without shrinkage or allowance for pork produced. It will be noticed that in the first test the steers fed corn and clover hay (with corn at 40 cents per bushel, which was slightly higher than the average price when fed), could have been sold at $5.38 per hundred, while those fed on corn, clover hay and silage could have been sold at $5.25 per hundred, while the actual values were $5.45 and $5.30 respectively. The value of the lot receiving no silage was seven cents greater, and that of the silage lot was five cents greater per hundred than the price necessary to break even without considering the value of hogs or manure. In the second test the steers fed no silage (with corn at 50 cents per bushel, which was the average price during the winter of 1907-8), could have been sold at $5.39 per hundred, and those fed silage at $5.37 per hundred, while he actual values were $5.95 and $6.00 respectively. The value of the lot receiving no silage was 56 cents and that receiving silage 63 cents per hundred greater than the necessary selling price.

The financial returns of the two lots fed in 1906-7 show that the profit per steer was practically the same whether fed on corn and clover or on corn, clover and silage. The excess price received per bushel for corn over its average market value was 1.5 cents greater in the lot receiving silage in connection with corn and clover hay than in the lot receiving no silage. There was but very little difference in the financial outcome of these lots, though it was slightly better in the lot receiving silage. The financial statements for the year 1907-8 show a profit of $18.41 in favor of the lot fed silage. The corn fed to this lot of cattle returned five cents more per bushel than that fed to the lot receiving corn and clover without silage. If the additional profit made during the second test, on account of adding silage to the ration was credited to silage, it would amount to $1.52 per ton; this added to the estimated price of silage gives $4.02 per ton as its feeding value.

THE VALUE OF CORN SILAGE FED WITH SHELLED CORN, CLOVER HAY AND COTTONSEED MEAL

A second experiment was conducted to determine the value of a ration composed of shelled corn, cottonseed meal, clover hay and

corn silage as compared with a similar ration without the silage. The initial value of these cattle was $4.00 per hundred in both lots. The initial weight was 1,123 pounds in the silage-fed lot and 1130 pounds per steer in the lot fed no silage. At the end of the six-months period, the lot receiving silage averaged 1602 pounds, while that receiving no silage weighed 1570 pounds.

The following table shows that the daily gain per steer was .22 pound greater in the lot receiving silage than in the lot receiving no silage. As in previous experiments reported, the lot receiving the greater amount of protein or a narrower ration consumed a greater amount of grain than the one receiving the wide ration, showing a difference of .62 pound daily per steer in the consumption of corn. The grain consumed per pound of gain was .88 pound less when silage was fed.

The cost of gains when silage was fed was $1.00 per hundred cheaper than in the lot where no silage was used, with corn at 50 cents per bushel, which was approximately the average price for the time this experiment was in progress. The price necessary to break even, based upon home weights, without considering the value of the pork produced, was 19 cents per hundred less in the silage lot than in the other, while the actual market value was the same. This indicates that the rate of gain while in the feed lot does not determine the finish secured. While the silage fed lot made a more rapid gain, the finish as measured by market values was no better than in the lot receiving no silage.

Table Showing Value of Corn Silage when Fed with Supplement in Fattening Two Year Old Steers

Date of Experiment. Length of Experiment. Ration Fed.	Nov. 17, 1907—May 15, 1908. 180 days.	
	Shelled corn, cotton-seed meal, clover hay, corn silage.	Shelled corn, cottonseed meal, clover hay.
Initial value per cwt.,	$4 00	$4 00
Initial weight (10 steers),	11,235 lbs.	11,300 lbs.
Final weight (10 steers),	16,021 "	15,700 "
Total gain,	4,786 "	4,400 "
Average daily gain per steer,	2.66 "	2.44 "
Total feed consumed:		
Shelled corn,	34,233 "	35,347 "
Cotton-seed meal,	4,869 "	4,820 "
Clover hay,	8,123 "	16,383 "
Corn silage,	26,990 "	.....

Table Showing Value of Corn Silage when Fed with Supplement in Fattening Two Year Old Steers—Continued.

Date of Experiment. Length of Experiment. Ration Fed.	Nov. 17, 1907—May 15, 1908. 180 days.	
	Shelled corn, cotton-seed meal, clover hay, corn silage.	Shelled corn, cotton-seed meal, clover hay.
Average feed consumed daily per steer:		
Shelled corn,	19.01 lbs.	19.63 lbs.
Cotton-seed meal,	2.70 "	2.67 "
Clover hay,	4.51 "	9.01 "
Corn silage,	14.99 "	.....
Feed per lb. gain:		
Shelled corn,	7.15 "	8.03 "
Cotton-seed meal,	1.02 "	1.09 "
Clover hay,	1.69 "	3.58 "
Corn silage,	5.64 "	.....
Cost of gain per cwt.:*		
Corn @ 40c per bu.,	$7 91	$8 75
Corn @ 50c per bu.,	9 18	10 18
Necessary selling price per cwt.:*		
Corn @ 40c per bu.,	$5 16	$5 33
Corn @ 50c per bu.,	5 54	5 73
Actual market value,	6 70	6 70

*Based upon the following prices:

Cotton-seed meal,	$28.00 per ton.
Clover hay,	8.00 per ton.
Corn silage,	2.50 per ton.

In the financial statement of these two lots it will be found that the profit per steer was $17.96 in the lot which received no silage, while it was $22.68 in the silage-fed lot. The excess price received per bushel for corn over market value was 8.6 cents per bushel greater when silage was fed. If all the additional profit made by feeding silage is credited to the silage fed, it would amount to $3.51 per ton, giving it a feeding value of $6.01 per ton when fed under similar conditions.

The summary of results from feeding silage during the winter of 1908-9 shows that the best results secured from a six-months feeding period were in the lot of cattle fed on shelled corn, cottonseed meal and corn silage without hay. In this test, all lots were fed at a profit, although that in the lot fed corn and clover hay was less than one-half as much as when cottonseed meal and corn silage were substituted for the clover hay. The addition of corn silage to a ration of shelled corn, cottonseed meal annd clover hay resulted in a more rapid and cheaper gain and a higher finish in the cattle as well as a greater financial gain

SUMMARY OF RESULTS OF WINTER FEEDING OF TWO YEAR OLD STEERS ON DIFFERENT RATIONS, 1908-1909*

Ration.	Lot 1. Shelled corn, cotton-seed meal, clover hay.	Lot 4. Shelled corn, cotton-seed meal, corn silage.	Lot 5. Shelled corn, cotton-seed meal, clover hay, corn silage.	Lot 6. Shelled corn, clover hay.
Initial value per cwt.,	$4 55	$4 55	$4 55	$4 55
Average initial weight,	966 lbs.	962.1 lbs.	963.1 lbs.	964.6 lbs.
Average final weight,	1,375.6 "	1,428 "	1,384.3 "	1,306.3 "
Average daily gain per steer,	2.27 "	2.58 "	2.33 "	1.89 "
Total feed consumed:				
Shelled corn,	31,280 "	28,475 "	30,305 "	34,731 "
Cotton-seed meal,	5,434 "	5,413 "	5,434 "	.....
Clover hay,	17,078 "	.....	8,930 "	17,902 "
Corn silage,	.....	53,090 "	27,617 "	.....
Average daily feed per steer:				
Shelled corn,	17.37 "	15.81 "	16.83 "	19.29 "
Cottonseed meal,	3.01 "	3 "	3.01 "	.....
Clover hay,	9.48 "	.....	4.96 "	9.94 "
Corn silage,	.....	29.49 "	15.34 "	.....
Average feed consumed per pound of gain:				
Shelled corn,	7.63 "	6.11 "	7.19 "	10.15 "
Cotton-seed meal,	1.32 "	1.16 "	1.29 "	.....
Clover hay,	4.12 "	.....	2.12 "	5.23 "
Corn silage,	.....	11.39 "	6.55 "	.....
Dry matter per pound gain,	11.52 "	9.98 "	11.34 "	13.59 "
Cost per cwt. gain,	$11 44	$9 39	$10 93	$12 35
Selling value of cattle in feed lots without shrinkage after six months feedings,	6.75	6 90	6 80	6 55
Profit per steer,	12 79	21 51	15 80	9 89
Price received per bushel for corn,†	79.3c	96.7c	85.8c	77.1c
Excess over market value,	20.5c	37.6c	26.1c	14.3c
Per cent. on investment for 6 months in cattle, hogs and feed,	12.5%	21.7%	15.6%	10.4%

†Based upon the following prices:
Cotton-seed meal, ...@ $28.00 per ton.
Clover hay, ...@ $ 8.00 per ton.
Corn silage, ...@ $ 2.50 per ton.

During the winters of 1910-11 and 1911-12 the work was continued at Purdue Experiment Station along lines similar to those of preceding years. A summary of this work is presented, together with a discussion of results as published in Bulletin 153.

Summary: The only satisfactory method of judging the economy of rations is to consider together all the controlling factors entering into the feeding operation. No single factor is a true measure of the economy of a ration. The great number of factors involved in cattle feeding makes it impossible, in a limited space, to clearly discuss

*Purdue Exp. Sta. Bulletin, 136.

them in their numerous and complex combinations. Therefore, the discussion of the trials as a complete transaction is presented, with such variable factors as weight and cost of cattle, cost of gains, selling price of cattle and profit or loss per steer as they occurred during the trial:

Summary of Results—1909-10

	November 17, 1909—April 26, 1910. (160 days.)			
	Lot 1.	Lot 2.	Lot 3.	Lot 4.
Date of experiment. Length of experiment. RATION.	Shelled corn, cotton-seed meal, clover hay, corn silage (morning) (evening.)	Shelled corn, cotton-seed meal, clover hay.	Shelled corn, cotton-seed meal, corn silage.	Shelled corn, cotton-seed meal, clover hay, corn silage (morning and evening.)
Initial value per cwt.,	$4 65	$4 65	$4 65	$4 65
Average initial weight,	900 lbs.	889.5 lbs.	897.5 lbs.	892.5 lbs.
Average final weight,	1,312.7 "	1,255 "	1,269.5 "	1,313 "
Total gain per steer,	412.7 "	365.5 "	372 "	420.5 "
Average daily gain per steer,	2.58 "	2.28 "	2.33 "	2.63 "
Total feed consumed:				
Shelled corn,	24,520 "	25,250 "	21,795 "	23,110 "
Cotton-seed meal,	4,171.5 "	4,028.5 "	3,808.5 "	4,134.5 "
Clover hay,	12,264 "	18,837 "	.....	7,086 "
Corn silage,	22,280 "	.....	44,276 "	44,418 "
Average daily feed per steer:				
Shelled corn,	15.33 "	15.78 "	13.62 "	14.44 "
Cotton-seed meal,	2.61 "	2.52 "	2.44 "	2.58 "
Clover hay,	7.67 "	11.77 "	.....	4.43 "
Corn silage,	13.93 "	.....	27.67 "	27.76 "
Fed consumed per lb. gain:				
Shelled corn,	5.94 "	6.91 "	5.86 "	5.50 "
Cotton-seed meal,	1.02 "	1.10 "	1.05 "	.98 "
Clover hay,	2.97 "	5.15 "	.....	1.69 "
Corn silage,	5.40	.....	11.90	10.56
Cost of gain per cwt.,	$9.76	$10.98	$9.42	$9.56
Necessary selling price,	6.26	6.49	6.95	6.22
Selling value of cattle in feed lots without shrinkage,	7.25	7.30	7.20	7.60
Profit per steer, (without pork),	13.02	10.12	14.64	18.09
Pork produced per lot,	900† lbs.	723† lbs.	620* lbs.	1,405* lbs.
Profit per steer (including pork).	$21.04	$16.54	$20.14	$28.21

*2,665 pounds of corn fed to hogs.
†Pork valued at nine cents per pound, 1909-10.
‡Pork valued at nine cents per pound, 1909-10.

Summary of Results—1910-11

Date of experiment. Length of experiment. RATION.	November 18, 1910—April 17, 1911. (150 days.)			
	Lot 1. Shelled corn, cotton-seed meal, clover hay, corn silage (morning) (evening.)	Lot 2. Shelled corn, cotton-seed meal, clover hay.	Lot 3. Shelled corn, cotton-seed meal, corn silage.	Lot 4. Shelled corn, cotton-seed meal, clover hay, corn silage (morning and evening.)
Initial value per cwt.,	$5.00	$5.00	$5.00	$5.00
Average initial weight,	1,122 lbs.	1,121.3 lbs.	1,121 lbs.	1,116.9 lbs.
Average final weight,	1,510.3 "	1,486.2 "	1,476.8 "	1,479.6 "
Total gain per steer,	388.3 "	364.9 "	355.8 "	362.7 "
Average daily gain per steer,	2.59	2.43	2.37	2.42
Total feed consumed:				
Shelled corn,	27,393 "	30,610 "	22,027 "	21,568 "
Cotton-seed meal,	4,565 "	4,439.5 "	4,563.5 "	4,505 "
Clover hay,	8,748 "	16,515 "	.....	6,753 "
Corn silage,	31,160 "	.....	57,255 "	46,493 "
Average daily feed per steer:				
Shelled corn,	18.26 "	20.41 "	14.68 "	14.38 "
Cotton-seed meal,	3.04 "	2.96 "	3.04 "	3.00 "
Clover hay,	5.83 "	11.01 "	.....	4.50 "
Corn silage,	20.77 "	.....	38.17 "	31.00 "
Feed consumed per lb. gain:				
Cotton-seed meal,	1.18 "	1.22 "	1.28 "	1.24 "
Shelled corn,	7.05 "	8.39 "	6.19 "	5.92 "
Clover hay,	2.25 "	4.53 "	.....	1.86 "
Corn silage,	8.02 "	.....	16.09 "	12.82 "
Cost of gain per cwt.,	$8.82	$9.71	$8.49	$8.71
Shelled corn,	7.05 "	8.39 "	6.19 "	5.95 "
Selling value of cattle in feed lots without shrinkage,	5.95	5.85	5.75	5.85
Profit per steer (without pork),	.50 loss	.457 loss	1.34 loss	.86 loss
Pork produced per lot,	810 lbs.	1,005 lbs.	790 lbs.	650 lbs.
Profit per steer (including pork),*	$4.36	$1.46	$3.40	$3.04

*Pork valued at six cents per pound, 1910-11.

In the above summary, the price of feeds are as follows for 1909-10: Clover hay, $10.00 per ton; cottonseed meal, $33.00 per ton; corn silage, $3.50 per ton; shelled corn, first month, 49.9 cents sec-; ond month, 55.7 cents; third month; 56.7 cents; fourth month, 53.7 cents; fifth month, 51.9 cents; last ten days, 50.2 cents per bushel. 1910-11: Shelled corn, first month, 36.1 cents; second month, 37 cents; third month, 37.8 cents; fourth month, 36.9 cents; and fifth month, 39.3 cents per bushel; cottonseed meal, $30.00 per ton; clover hay, $10.00 per ton; corn silage, $3.00 per ton. No account is included of the straw used as beddiing nor the labor of feeding.

The unusually large returns of 1909-10 and the extremely small profits of 1910-11 are due to the condition of the market at the end of the two trials. The spring of 1910 saw an abnormally high market for all classes of meat animals, while, considering the high price of feeding cattle in the fall of 1910, the spring of 1911 witnessed a very dull and unsatisfactory market. Considering the trial as a whole, the ration of shelled corn, cottonseed meal and clover hay proved to be the least profitable of the four. This was not due to small gains or a lack of finish on the cattle, but to the greater cost of gains. With the initial weight of 889.5 pounds in 1909-10 and 1121.3 pounds in 1910-11 at a cost in the feed lots of $4.65 and $5.00 per cwt. respectively the necessary margin to come out even on the cattle was $1.84 per cwt. in the former case and $1.16 per cwt. in the latter. The selling price was such that a profit without pork of $10.12 per steer in 1909-10 and a loss of $4.57 per steer in 1910-11 was returned in Lot 2 receiving the clover hay only, as roughage.

By the addition of a limited number of corn silage to the ration, the rate of gain was increased and the cost of gain decreased to such an extent that the cattle could have sold for 23 cents less per cwt. in 1909-10 and 18 cents less per cwt. in 1910-11 than Lot 2 and still make the same returns to the feeder. The cattle sold practically the same. Lot 1 returned a profit of $2.90 per steer more the first year, and a smaller loss by $4.07 per steer the second year than Lot 2 receiving no silage. When the pork produced from the droppings is considered, there was a profit of $21.04 and $16.54 per steer for Lots 1 and 2 respectively of 1909-10 and a profit of $4.36 and $1.46 per steer for the same lots of 1910-11. The effect of adding a limited amount of corn silage to a ration of corn, cottonseed meal and clover was to decrease the cost of gains very materially without greatly affecting the other factors in the feeding operation, thereby returning an appreciably larger profit per steer.

The comparative economy of feeding in connection with clover hay, corn silage in unlimited quantities instead of once daily is shown by comparing Lots 4 and 1. The rate of gain is approximately the same, and the cost of gain is slightly less when a full feed of silage is given. The necessary margin required to come out even on the cattle was four cents in 1909-10 and seven cents in 1910-11 more per cwt. for the half than for the full feed of silage. The selling value of the cattle was 35 cents per cwt. higher in 1909-10 and 10 cents per cwt. lower in 1910-11 for the full fed silage lot than for the half fed silage lot, thereby giving a return of $5.07 more profit per steer in 1909-10 and 35 cents more loss per steer in 1910-11. It must be borne in mind, however, in connection with the effect of the amount of silage to use in a ration, that after the cattle are half-fat the amount of silage must be decreased in order to secure satisfactory results.

The effect of entirely replacing clover hay with corn silage for roughage was to reduce the rate of gain somewhat from that made when clover hay and corn silage was fed to about the same gain as was made when clover hay was the only roughage. The cost of gain, which was greatly reduced by substituting silage for clover hay, was least in Lot 3 of any of the lots fed in the two trials. The necessary margin was 17 cents and seven cents per cwt. for 1909-10 and 1910-11 respectively less than Lot 4 receiving a full feed of silage and clover which required the next smallest margin to make the cattle pay for their original cost and feed. The cattle, however, did not acquire as good finish as when clover hay was contained in the ration, so that the profit per steer was not greatly different for the two years, from that returned by the rations containing both silage and clover hay.

The four rations indicate very strongly that the more nearly the clover hay is replaced by corn silage, the greater is the reduction in the cost of making gains, but that for the latter half of the fattening period, the roughage must be limited to such amounts that enough of grain will be eaten to return satisfactory gains. Otherwise there will be a lack of finish on cattle that will partially or entirely overcome the advantage derived from the more economical gains.

OHIO EXPERIMENT STATION RESULTS WITH CORN SILAGE*

During the winter of 1907-8, the Ohio Experiment Station conducted an experiment similar to those previously noted, with results that are quite comparable in that they show a decided reduction in cost of gains and increased profit from its use. The following data is from Bulletin 193.

The following table shows the total gains and average daily gain per steer made by the three lots fed silage that were dry-fed, together with the total cost of feed consumed by the two sets of three lots each, and the cost of 100 pounds gain in live weight. The average daily gain per steer was almost exactly the same for both of the sets, so there is no apparent difference between the two rations so far as rate of gain is concerned. But rate of gain is only one of the profit deciding factors. The costs of gains, on the basis of the prevailing market prices of feed, are quite widely apart. This cost of gains, it must be understood, is based upon an uncertainty varying factor—market prices for feeds.

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*Ohio Exp. Sta. Bulletin, 193.

FEED CONSUMED, GAINS PRODUCED AND COST OF GAINS

	Silage-fed—Lots 1, 3 and 5 20 head.		Dry-fed—Lots 2, 4 and 6 21 head.	
	Amount.	Value.	Amount.	Value.
Corn @ 45 cents per bushel,	746.143 bus.	$335.764	934.054 bus.	$420.324
Cottonseed meal @ $26.50 per ton,	2.420 tons	64.100	2.537 tons	67.231
Silage @ $3.00 per ton,	34.073 "	102.219	.....	.....
Stover @ $4.00 per ton,	1.098 "	4.392	2.453 "	9.812
Hay @ $12.00 per ton,	7.011 "	84.132	16.435 "	197.220
Total cost of feed consumed,	.....	$590.637	.....	$694.587
Gains produced,	6,531 lbs.	.....	6,801 lbs.	.....
Average daily gain per steer,	2,333 "	.....	2.313 "	.....
Cost per 100 lbs. gain,	.....	$9 04	.....	$10 21

REPLACEMENT VALUE OF CORN SILAGE

To put the whole matter upon a more definite basis, the replacement value of a ton of silage for beef production has been computed. This table takes into consideration the lower pork production when silage is used. It was found that under the conditions of this experiment, one ton of silage was equivalent to or replaced 4.4266 bushels of corn, .0369 tons of corn stover and .257 ton of mixed hay, so far as gains by the cattle are concerned. Since both sets of steers received the same amount of cottonseed meal replaced in so small an amount—less than one pound—that it is not taken into consideration. Using these figures, we may determine the value of a ton of corn silage as shown in this test, for any market conditions. For the purpose of showing the need for considering various market conditions, a table has been prepared. Even if the lowest of the assumed prices had prevailed, it is seen that corn silage would have proved a very valuable feed. With the highest assumed prices the replacement value of the corn silage is found to be $4.63 per ton.

REPLACEMENT VALUE OF SILAGE

Corn per bushel,		$ 30	$ 40	$ 60
Stover per ton,		3 00	4 00	5 00
Hay per ton,		6 00	8 00	10 00
1 ton silage for beef production,	4.4266 bus. corn, ..	$1 33	$1 77	$2 21
	.0369 ton stover, ..	11	15	18
	.2574 ton hay, ...	1 54	2 08	2 57
		$2 98	$3 98	$4 96
6.6 pounds less pork produced per ton silage, @ 5 cents per pound, ..		33	33	33
Net replacement value of silage per ton,		$2 65	$3 65	$4 63

Aside from the replacement value of corn silage, there are various considerations that should be taken into account when we decide whether or not to use silage. (a) Harvesting silage is heavy work and comes at a season of the year when there is other work on hand. (b) Special machinery is required to make silage. (c) Silage should be fed in a place that does not freeze very readily. (d) There is considerable danger of silage spoiling in the silo when fed very slowly, especially during warm weather. The common rule is: Feed at least an inch in depth from the silo each day in winter, two inches in summer. This rule cannot be said to be exactly applicable to all cases, but is probably not far wrong for Ohio conditions.

Some of the advantages of the use of silage are: (a) Practically all of the corn crop is utilized. (b) The field is in good condition for fall cultivation after the corn has been removed. (c) The silo affords very economical storage. (d) If proper arrangements are made, silage is a most convenient feed to handle. (e) If well stored, silage does not deteriorate in palatability as does corn stover late in the spring. (f) Less loss results in seasons which do not favor a complete maturing of the crop, as corn may be used for silage to good advantage even if not thoroughly matured.

After all these points have been taken into consideration, the feeder will need to apply them to his own special conditions before he can say definitely that the silo is or is not valuable for his use.

During the winter of 1910-11, the Illinois Experiment Station conducted an experiment to determine the comparative value of silage and other feeds, the results of which are presented in this connection.

RESULTS OF FEEDING EXPERIMENT 1910-11, ILLINOIS EXPERIMENT STATION

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.	Lot.6.	Lot 7.
Initial weight, pounds,	941.00	944.50	928.00	943.00	914.00	913.50	922.50
Final weight, pounds,	1,259.67	1,218.67	1,218.67	1,242.83	1,235.83	1,287.67	1,180.50
Average daily gain, pounds,	2.539	2.175	2.307	2.38	2.554	2.874	2.04
Average daily feed consumed:							
Broken ear corn,	15.13	15.20	16.04	16.07	15.99	18.73	18.04
Cotton-seed meal,	2.28	2.23	2.74	.....	2.78	1.11	.....
Corn silage,	26.43	26.75	25.85	25.34	31.72	.....	26.66
Alfalfa hay,	3.37	.....	.....	4.31	.....	9.63	.....
Clover hay,	2.15	.....	.....	.....	.....	.....	2.04
Corn stover (fed),	.....	.....	2.48	.....	.....	.....	.....
Cost of gains, per cwt.,	$7 58	$8 07	$7 73	$7 17	$7 27	$6 72	$7 26
Necessary selling price (pork not included),	5 58	5 61	5 57	5 45	5 52	5 43	5 41
Necessary selling price (pork included),	5 40	5 43	5 38	5 26	5 35	5 24	5 26
Total pork produced per lot, pounds,	371.00	376.00	386.00	397 00	348 00	418 00	309 00
Pork, per bu., broken ear corn fed cattle,	1.36	1.37	1.34	1.37	1.21	1.24	1 07
Necessary selling price to insure 6 per cent. interest on money invested in cattle, hogs and feed for one-third year,	$5 52	$5 55	$5 56	$5 37	$5 47	$5 35	$5 37
Actual value in lots,	5 75	5 75	5 65	5 75	5 75	6 00	5 65
Actual profit per steer,	4 41	3 90	3 29	6 09	4 94	9 78	4 60

Initial value of feeders (4.65 Chicago), 4.90 in lots.
Corn, 40 cents per bushel.
Alfalfa, $16 per ton.
Clover hay, $12 per ton.
Stover, $3 per ton.
C. S. M., $30 per ton or 1½ cents per pound.
Silage, $3.50 per ton.

The use of broken ear corn instead of shelled corn in preceding experiments and the use of alfalfa hay as a source of protein in roughage are two conditions that were not present in the work done at Ohio or Indiana. This test clearly demonstrates the value of alfalfa over other hay crops. Where silage was fed in connection with cottonseed meal and broken ear corn, there was an increase in the rate of gains, a decrease in the cost and an additional profit shown as compared with clover hay as a roughage. This data is also interesting in that it shows the amount of pork produced per bushel of ear corn fed to cattle. This is a source of profit frequently overlooked by eastern feeders who feed in stanchions where hogs have no opportunity to utilize the waste from cattle feeding.

SILAGE FED STEERS MARKETED BY THE IOWA EXPERIMENT STATION

The Iowa Experiment Station marketed in April, 1911, forty choice two-year-old experimental steers which were used in a cattle feeding trial to demonstrate the practicability of silage feeding as compared to clover. Twenty of them were brought from Wyoming and twenty of them from Nebraska ranges. These cattle were so divided in the four lots of ten each that five Nebraska and five Wyoming steers were grouped together in each lot.

The rations fed in the four different lots were as follows:

Lot 1—Shelled corn, cottonseed meal, clover hay.

Lot 2—Shelled corn, cottonseed meal (last sixty days only), clover hay and silage (limited).

Lot 3—Shelled corn, cottonseed meal, clover hay and corn silage (unlimited).

Lot 4—Shelled corn, cottonseed meal and corn silage, (unlimited).

The feeds were valued as follows:

Shelled corn, 36c. per bushel.

Cottonseed meal, $28.00 per ton.

Clover hay, $10.00 per ton.

Corn silage, $2.50 per ton.

The valuations for corn, cottonseed meal and clover hay were based upon the current valuations during the progress of the experiment.

The general summary of the experiment by lots follows:

RESUME 1910-1911 STEER FEEDING

Record, Nov. 22-April 21, 150 days. Ten steers in a lot.

	Lot 1. Shelled corn, cotton-seed meal, clover.	Lot 2. Shelled corn, cotton-seed meal—last 60 days only, clover, silage.	Lot 3. Shelled corn, clover cotton-seed meal, silage.	Lot 4. Shelled corn, cotton-seed meal, silage.
Initial weight,	977.8	1,008	988.7	993.6
Final weight,	1,370.0	1,302.6	1,522.3	1,362.2
Total gain per steer,	392.2	204.6	333.6	363.6
Average daily gain,	2.61	1.96	2.22	2.45
Average daily feed eaten:				
Shelled corn,	19.24	14.58	14.07	14.93
Cotton-seed meal,	2.07	.88	2.54	3.31
Clover hay,	10.83	6.65	4.35	.....
Corn silage,	.....	18.45	23.86	30.15
Feed required per pound gain:				
Shelled corn,	7.36	7.42	6.33	6.08
Cotton-seed meal,	.79	.45	1.14	1.34
Clover hay,	4.14	3.39	1.96	.....
Corn silage,	.....	9.39	10.75	12.27
Cost per 100 lbs. gain, excluding pork profits,	$7.91	$8.26	$7.99	$7.32
Profit returned by hogs at $6.00 per cwt. for each 100 lbs. gain on steers,	1.47	1.44	1.55	1.55
Net cost per pound (including pork profits), gain on steers,	6.44	6.82	6.46	5.77
Total pork produced per lot,	1,497	1,243	1,386	1,490
Pork produced for each 100 lbs. shelled corn fed steers, disregarding extra feed which was same in all lots,	$5.187	$5.683	$5.565	$6.653
Initial cost of feeders in lots per cwt.,	5.50	5.50	5.50	5.50
Necessary selling price Chicago, including hog profits,	6.20	6.18	6.15	6.02
Chicago selling price,	6.00	5.90	6.10	6.00
Market weight at Chicago per steer	1.333	1.283	1.296	1.325
Total shrink per steer,	35	19.8	26.3	37.2
Per cent. shrink,	2.548	1.504	1.989	2.731

The efficiency of silage for short feeding was abudantly demonstrated. In other words the silage cattle did best in comparison with the clover lot during the first ninety to one hundred twenty days, and from that time on until the finish of the experiment made comparatively less economical gain than did the steers feeding upon clover.

The following table illustrates this point quite clearly. In it are shown the daily gains for three, four and five months feeding respectively and also the cost per cwt. of gain by these same periods.

	Lot 1.	Lot 2. Lot 3.	Lot 4.
	Shelled corn, cotton-seed meal, clover.	Shelled corn, cotton-seed meal, silage and clover.	Shelled corn, cotton-seed meal, silage.
Average daily gains.			
First 90 days,	2.30	2.73	3.11
First 120 days,	2.68	2.44	2.68
Entire period, 150 days,	2.61	2.22	2.45
Cost of 100 lbs. gain not counting pork produced.			
First 90 days,	$7.15	$6.39	$5.84
First 120 days,	7.84	7.27	6.12
Entire period, 150 days,	7.91	7.99	7.38

In comparison made, only Lots 1, 3 and 4 are given, because Lot 2 is not quite comparable to the other lots because they did not receive cottonseed meal during the first three months of the feeding period.

The exclusive silage roughness steers made the cheapest gain for the entire feeding period. It is also worthy of notice that the ration having the largest proportion of silage made the most economical gain both including and excluding pork profits. That silage is a cheap meat producer is shown in the data.

Although these cattle were sold upon a disastrous market, it is exceedingly gratifying to know that the silage-fed cattle practically held their own. In other words, they lacked only 2 cents per cwt. of paying for all the feed they ate. This is counting the pork that is picked up from the droppings.

The cost of silage is figured in the above table at $2.50 per ton, but actually this silage cost the station $1.92. The corn from which the silage was made yielded 15 tons per acre and was bought in the field at 8 cents below the market price of $.36. It husked 60 bushels of shelled corn to the acre. The corn in the field was valued at 8 cents below the market price, because it will take 5 cents to husk and crib it and 3 cents to haul it to town. Hence, when corn on the average Iowa market sells for $.30 per bushel, it is worth in the field practically $.28 per bushel. At this rate the silage corn standing in the field will yield 15 tons to the acre and the cost would be $1.19 per ton in the stalk. It cost $.73 per ton to cut this corn and put it into the silo. This added to the original cost of $1.19 in the field makes a total of $1.92 per ton. This cost includes the wear and tear on the silage machinery, the labor, twine, corn binder, etc. The total cost of $1.92 per ton, however, does not include the cost of the silo and its depreciation. Hence it will be seen that the value of $2.50 per ton really allows $.58 more than actual cost of the silage, which would be more than sufficient to allow for the depreciation and interest in the investment.

Undoubtedly there is a great deal to be learned concerning the manner in which silage should be fed, and it is with these ideas in mind that the Iowa Station is taking up the problem. The results this year would indicate that silage can be profitably limited during the last two months of the feeding period, and this matter will be given thorough test during the coming winter.

FULL FEED VS. HALF FEED OF SILAGE COMPARED

From Bulletin 102, published by the Pennsylvania Experiment Station, the following data is presented in regard to the feeding of a full feed of corn silage as compared with a half feed throughout a period of 140 days.

Feeding Experiment, 1909-10

Method of Feeding.	Lot 1. Full feed grain, ½ feed roughage (in silage, barn.)	Lot 3. Full feed grain, full feed roughage (in silage, barn.)
Length of feeding period,	140 days	140 days
Initial weight, December 14, 1909.	9,565 lbs.	9,700 lbs.
Initial cost per cwt.,	$5 00	$5 00
Final weight May 13, 1910,	13,061.1 lbs.	13,291.6 lbs.
Total gain,	3,526.6 "	3,591.6 "
Average daily gain per head,	2.099 "	2.133 "
Total feed consumed:		
Ear corn,	8,480 lbs.	8,540 lbs.
Shelled corn,	16,129 "	16,129 "
Cotton-seed meal,	3,172 "	3,051 "
Shredded stover,	8,011 "	3,943 "
Mixed hay,	4,836 "	2,815 "
Corn silage,	16,380 "	28,505 "
Total air-dry matter consumed,	37,745.6 lbs.	36,859.05 lbs.
Air-dry matter per 100 lbs. gain,	1,070.29 "	1,026.24 "
Total cost of feed,*	$396 46	$396 87
Cost of feed per 100 lbs. gain,	11.244	11.05
Final cost cattle per cwt.,	6.684	6.634
Total cost cattle and feed,	$873.21	$881.87
Final value of cattle per cwt.,	7.60	7.60
Final value per lot,	992.68	1,010.16
Total profit per lot,	119.47	128.29
Total profit per steer,	9.95	10.69
Price received per bu. corn,	.971	.992

*Based on the following prices of feeds: Corn, $00.677 bu.; Cotton-seed meal, $34.00 per ton; Stover, $3.50 per ton; Silage, $3.00 ton; Mixed hay, $12.00 per ton.

It may be noticed that the cattle fed silage to the limit of their appetites made slightly more rapid and cheaper gains than those fed only one-half as much. The increased gain did not affect the finish of the cattle as indicated by their selling value per cwt. This indicates, as have the results in other states, that the value of silage comes chiefly from reducing the cost of feeding and shortening the feeding period rather than adding to the value per hundred weight of the cattle when finished.

It seems worthy of note in this connection that similar results at all of the experiment stations in the corn belt as well as in adjoining states have been secured by the use of corn silage as a feed for fattening animals. It is no longer in an experimental stage, the only doubt being as to the most profitable length of feeding period and the advisability of limiting the quantity to be consumed during the last stage of the fattening period. Unless steers are made excessively fat, it is very doubtful whether the amount of their feed should be reduced. The results also show the inadvisability of attempting to use silage without the use of a nitrogenuos concentrate, such as cottonseed meal, in connection with it where alfalfa hay is not available.

CHAPTER XII

SILAGE FOR FATTENING CATTLE*

As the value of hay, corn and other feeds generally used for fattening beef cattle, has shown a tendency to increase very rapidly, many who consider it necessary to finish steers for market in order to keep up the fertility of the soil are tempted to abandon the making of beef, sell the grain and roughage produced and depend upon restoring the plant food in the form of green manures and commercial fertilizers. This experiment is a continuation of the work previously reported in Bulletin 102 and the Annual Report of the Pennsylvania School of Agriculture and Experiment Station for the year ending June 30, 1911, which has been continued in order to determine profitable methods of steer feeding under Pennsylvania conditions.

Experiments at this and other Stations have shown that the addition of corn silage to the rations that are usually fed to fattening animals results in cheaper and more rapid gains in the feed lot and because of its succulent nature causes cattle to shed off early and look more attractive than those fed exclusively on dry feeds. A further advantage in Pennsylvania is that an excellent quality of corn silage can be produced in localities where the season is too short for corn to mature.

The purpose of this experiment was to determine to what extent silage could be profitably used in steer feeding. Twenty-seven grade Shorthorn and Hereford steers were purchased on the open market

*By Prof. B. O. Severson.

in Pittsburgh for this purpose. Three of them were used for other purposes, and the remaining twenty-four head were entered into the silage test.

THE COST OF CATTLE AT MARKET VS. DELIVERED INTO FEED LOTS

In order that a full and complete record of the cattle may be available, the following data is inserted:

Nov. 16.	To 23 cattle, wt. 19,450 lbs. at $4.90 per cwt.		$953.05
	To 4 cattle, wt. 3,340 lbs. at $5.00 per cwt.		167.00
	To freight Pittsburg to State College		34.36
Dec. 1.	Feeds used preliminary to beginning of test:		
	Mixed hay, 6310 lbs. at $12.00 per ton	$37.86	
	Corn silage, 6100 lbs. at $2.50 per ton	7.62	
	Cottonseed meal, 90 lbs. at $30.00 per ton	1.35	46 83
	Total cost of 27 cattle Dec. 1, 1911,		$1201 24
	By value of 4 cattle used for other purposes		127.03
	Total cost of 24 cattle at beginning of experiment		$1074.21
	Total weight of 27 cattle Dec. 1, 1912		23,692 lbs.
	Total weight of 27 cattle Nov. 13, 1911		22,790 "
	Gain during preliminary feed		902 "
	Average gain per head		33.5 "
	Total weight of 24 experimental steers		21,175 lbs.
	Average cost per cwt.		$5.07

It will be seen from this data that the cost of the cattle delivered in the feed lots after paying freight and preliminary feeding expenses was 16 cents per hundred more than their cost in the yards. The hay used during this period was of inferior quality and the silage was damaged to some extent, hence the price is lower than for that used in the experiment. During this period, 12 of the steers were dehorned in order that they might not be a source of disturbance to others which had been dehorned before purchased.

The cattle used classified as fair to good feeding cattle. They showed evidence of an infusion of beef blood upon a "scrub" foundation. They did not possess the weight, type or quality or condition of the best feeding cattle, but were selected with a view of having a bunch of steers that would represent an average grade used throughcut the State. They cost approximately one dollar per hundred less than choice to fancy cattle were quoted upon the Chicago market at the time of purchase.

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*See Bulletin 112.

METHOD OF FEEDING AND SHELTERING

The 24 steers were divided into two lots as nearly alike as possible in age, weight, breeding, quality, condition and temperament, designated as Lot 1 and Lot 2. Each lot was given all of the corn silage they would consume and two pounds of cottonseed meal per head daily. As previous experiments at this Station have shown that a limited grain ration was more profitable than a full feed during the early part of the fattening process, Lot 1 was fed approximately three-fourths of a full feed of ear corn during the first two months, after which they were given all that they would eat without waste until the close of the experiment. Lot 2 was not fed any corn until the beginning of the third month, when ear corn was added to their ration of silage and cottonseed meal in approximately the same amount as was fed to Lot 1 during the experiment. In each case, the ear of corn was broken into 2 or 3 pieces to facilitate its handling by the cattle. A sufficient number of hogs was allowed to run with the cattle, so that there could be no waste of grain which the cattle had failed to masticate and digest.

Each group of steers was housed in an open shed, boarded up closely on three sides, with the south side open. Adjoining the shed was an open lot to which the steers had access at all times. The shed was kept bedded at all times. Water was supplied from galvanized iron troughs located outside the lots, one board being removed from the fence in order that the steers might have access to them at all times.

The accompanying table is presented to show the conditions of the various feeds. Lot 1 were slightly more attractive, being smoother and more evenly covered.

SUMMARY

Steer Feeding Experiment Winter 1911-12

	Lot 1. (12 steers.)	Lot 2. (12 steers.)
Length of feeding period,	126 days	126 days
Initial value per cwt. in feed lots,	$5.07	$5.07
Initial weight,	10,615 lbs.	10,560 lbs.
Final weight,	13,425 "	13,360 "
Total gain,	2,810 "	2,810 "
Average daily gain per steer,	1.86 "	1.85 "
Total feed consumed:		
Ear corn,	20,892.5 "	11,377.5 "
Cotton-seed meal,	3,167 "	3,167 "
Corn silage,	34,087.9 "	50,397.2 "
Air-dry matter consumed,	31,403.4 "	30,037.9 "
Average daily feed per steer:		
Ear corn,	13.81 "	7.52 "
Cotton-seed meal,	2.09 "	2.09 "
Corn silage,	22.54 "	33.33 "
Average air-dry matter consumed per steer daily,	20.76 "	19.86 "
Total cost of feed,*	$319.25	$252.64
Cost of feed per 100 lbs. gain,*	11.36	9.02
Total cost of cattle and feed,	$857.43	788.03
Cost per cwt. at close of experiment,	6.39	5.90
Selling value per cwt. in Pittsburgh,	7.20	7.00
Selling value at home,	6.52	6.32
Net receipts,	$875.58	$844.35
Total profit,*	18.15	56.32
Price received per bushel of corn fed after paying for other feeds,	76.1c	$1.04.6
Price received per ton for silage after paying for other feed,	$4.65	$5.73

*Based upon ear corn at 70 cents per bushel; cotton-seed meal, $32.00 per ton, and corn silage, $3.50 per ton.

The summary of the experiment shows that the feeding of corn silage as the only roughage resulted in satisfactory gains in each lot, and that while there was a profit in feeding ear corn throughout the entire feeding period, a greater profit was secured when light plain feeders averaging 880 pounds at the beginning of the feeding period were carried for two month on a ration consisting entirely of corn silage, followed with a grain ration toward the end of the feeding period. In estimating profits, full market value has been allowed for all feeds so as to cover the labor in feeding. No credit is given for manure or for pork produced from the droppings of the

cattle. It is generally estimated that hogs following steers will gain 2 pounds for each bushel of ear corn fed to cattle. If this additional increase were allowed, the profit in Lot 1 would be increased $47.84, and in Lot 2 $26.80 over and above that indicated in the summary. A record of bedding used and manure produced was kept, which shows that 25,675 pounds of sawdust and 2762 pounds of straw were used for bedding.

The manure weighed out amounted to 101,560 pounds. Allowing $1.00 per ton for sawdust (the cost delivered at barn), $8.00 per ton for straw and $1.50 per ton for manure there was an additional profit of $31.24 to that made from direct feeding of steers and production of pork from droppings in Lot 1 during the 126 days of feeding. This shows that in cattle feeding, the profits secured from the by-products of feed lots may amount to more than the direct financial gain on the cattle. The test shows conclusively that silage can be used as roughage even in the coldest of winter when fed in an open shed; that there was a considerable saving of corn by the exclusive use of silage during the first part of the feeding period and that the value of feeds utilized in the production of beef during the winter of 1911-12 was much greater than their market value. The results of this and other tests at The Pennsylvania State College and Experiment Station indicate that beef can be finished profitably in the State, where due attention is paid to the growth of crops equally adaptable to the soil and to feeding purposes.

AN INDIANA EXPERIMENT, PURDUE EXPERIMENT STATION*

The object of the experiment of the winter of 1910-11 was: First, to secure additional data on the value of corn silage for fattening beef cattle; second, to secure information on the best amount of cottonseed meal in a ration for fattening cattle; third, to test the efficiency of corn silage and other roughage without grain for the first 60 days of the feeding period.

*By Prof. F. G. King.

In the first division of the experiment the basal ration of shelled corn, 2½ pounds of cottonseed meal daily per thousand pounds live weight, and clover hay was fed and designated as Lot 2. Lot 1 was fed the same as Lot 2 except that instead of feeding clover hay once daily thereby showing a partial replacement of clover hay by corn silage. Lot 3 was fed corn silage, without clover hay, in connection with shelled corn and cottonseed meal thereby showing a complete replacement of clover hay by corn silage. Lot 4, in addition to shelled corn and cottonsed meal, was fed all the clover hay and corn silage they would eat thereby allowing the cattle to be their own judges as to the proper amount of each roughage to consume.

In the second portion of the experiment the rations were the same, except in the quantity of the cottonseed meal fed. Lot 5 was fed the same as Lot 1, except that only one-half as much cottonseed meal was fed. Lot 6 was the same as Lot 2, except that one-half as much cottonseed meal was fed.

In the third portion of the experiment Lot 7 was fed the same as Lot 4, except that no corn was fed the first 60 days.

The experiment of 1911-12 was largely a reproduction of the one of 1910-11. The first division for testing the value of corn silage in a ration for fattening cattle and the most economical proportions to feed was continued without change of plan. The third division to secure data on the value of corn silage without grain, during the earlier part of the fattening period was continued with the exception, that instead of corn silage and clover hay being used as roughage, corn silage, oat straw, and 2 pounds of cottonseed meal daily per steer, were fed during the first 60 days of the trial and thereafter shelled corn was added to the ration and cottonseed meal increased until 2½ pounds daily per thousand pounds live weight was fed.

Instead of continuing division two on the comparison of different proportions of cottonseed meal a comparison between oat straw and clover hay, in connection with corn silage was made. It had been found by previous experiments that cattle receiving corn silage desired some dry roughage. Since the quantity of clover hay consumed in connection with a full feed of corn silage, was too small to account for the beneficial results secured it was considered advisable to secure data on the question of whether almost any form of dry roughage might not serve practically the same purpose as clover hay, in a ration where the cattle are receiving a full feed of corn silage in connection with shelled corn and cottonseed meal. There-

fore, Lot 6 was fed the same as Lot 4, except that oat straw replaced the clover hay in the ration. Also in order that a full comparison might be made between clover hay and oat straw in connection with corn silage, Lot 5 was fed the same as Lot 1, except that oat straw replaced the hay.

SUMMARY OF CATTLE FEEDING AT PURDUE UNIVERSITY EXPERIMENT STATION, WINTER 1910-11

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.	Lot 6.	Lot 7.
Length of feeding period,	150 days.	150 days.	150 days.	150 days.	150 days.	150 days.	150 days.
Initial value, November 18, 1910,	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00
Initial weight,	11,220 lbs	11,213 lbs.	11,210 lbs.	11,169 lbs.	11,148 lbs.	11,228 lbs.	11,225 lbs.
Final weight,	14,103 "	14,862 "	14,768 "	14,796 "	14,655 "	14,750 "	14,320 "
Total gain,	2,883 "	3,649 "	3,558 "	3,627 "	3,507 "	3,522 "	3,095 "
Average daily gain per steer,	2.59 "	2.43 "	2.37 "	2.43 "	2.34 "	2.35 "	2.06 "
Total feed consumed:							
Shelled corn,	27,393 "	30,610 "	22,027 "	21,568 "	27,850 "	30,320 "	13,340 "
Cotton-seed meal,	4,565 "	4,439.5 "	4,563.5 "	4,505 "	2,257.5 "	2,238.5 "	2,905 "
Clover hay,	8,748 "	16,515 "	.....	6,754 "	8,455 "	16,735 "	9,690 "
Corn silage,	31,160 "	.....	57,255 "	46,493 "	28,890 "	.....	57,640 "
Average daily feed per steer:							
Shelled corn,	18.26 "	20.41 "	14.68 "	14.38 "	18.57 "	20.21 "	8.89 "
Cotton-seed meal,	3.04 "	2.96 "	3.64 "	3.00 "	1.505 "	1.485 "	1.94 "
Clover hay,	5.83 "	11.01 "	.....	4.50 "	5.64 "	11.16 "	6.40 "
Corn silage,	20.77 "	.....	38.17 "	30.99 "	19.20 "	.....	38.43 "
Feed per pound gain:							
Shelled corn,	7.05 "	8.39 "	6.19 "	5.95 "	7.94 "	8.61 "	4.31 "
Cotton-seed meal,	1.175 "	1.22 "	1.28 "	1.24 "	.64 "	.63 "	.94 "
Clover hay,	2.25 "	4.53 "	.....	1.86 "	2.41 "	4.75 "	2.13 "
Corn silage,	8.02 "	.....	16.09 "	12.83 "	8.24 "	.....	18.62 "
Cost of gains per cwt.,	9.13	$10.08	$8.76	$8.96	$9.08	$9.47	$8.85
Necessary selling price,	6.06	6.25	5.91	5.97	5.98	6.07	5.83
Actual value in lots,	5.95	5.85	5.75	5.85	5.70	5.60	5.60
Pork produced from droppings,	810 lbs.	1,005 lbs.	790 lbs.	650 lbs.	805 lbs.	840 lbs.	502 lbs.
Profit or loss per steer:							
Including pork, profit,	$3.16	$0.13	$2.44	$2.10	$0.78	$1.85 loss.	.29 loss.
Not including pork, loss,	1.70	5.90	2.30	1.80	4.05	6.91	3.31

These figures are based upon the following prices for feeds:
Shelled corn, 40 cents per busbel.
Cottonseed-meal, $3.00 per ton.
Clover hay, $10.00 per ton.
Corn silage, $3.00 per ton.
Pork is figured at $6.00 per cwt. and 40 cents per cwt. deducted from final value of cattle to cover shipping.

SUMMARY OF CATTLE FEEDING AT PURDUE UNIVERSITY EXPERIMENT STATION, WINTER 1911-12

	Lot 1	Lot 2.	Lot 3.	Lot 4.	Lot 5.	Lot 6.	Lot 7.
Initial value, November 17, 1911,	$5.55	$5.55	$5.55	$5.55	$5.55	$5.55	$5.55
Initial weight, November 17, 1911,	9,652 lbs.	9,660 lbs.	9,687 lbs.	9,637 lbs.	9,680 lbs.	9,687 lbs.	9,642 lbs.
Final weight, April 25, 1912,	12,398 "	13,460 "	13,720 "	13,353 "	13,135 "	13,530 "	13,160 "
Total gain,	3,745 "	3,800 "	4,033 "	3,716 "	3,455 "	3,843 "	3,518 "
Average daily gain,	2.34 "	2.375 "	2.52 "	2.32 "	2.16 "	2.40 "	2.20 "
Total feed consumed:							
Shelled corn,	24,645 "	28,605 "	23,570 "	21,885 "	23,900 "	22,200 "	14,255 "
Cotton-seed meal,	4,461 "	4,437 "	4,562.5 "	4,452.5 "	4,331 "	4,467.5 "	4,060 "
Clover hay,	9,298 "	17,848 "	.....	4,071 "	.....	.....	.....
Oat straw,	.....	.....	.....	.....	6,740 "	3,695 "	5,550 "
Corn silage,	25,650 "	.....	43,810 "	39,664 "	25,550 "	40,410 "	47,750 "
Daily feed per steer:							
Shelled corn,	15.40 "	17.88 "	14.73 "	13.68 "	14.94 "	13.88 "	8.91 "
Cotton-seed meal,	2.75 "	2.77 "	2.85 "	2.78 "	2.71 "	2.79 "	2.54 "
Clover hay,	5.81 "	11.16 "	.....	2.54 "	.....	.....	.....
Oat straw,	.....	.....	.....	.....	4.21 "	2.31 "	3.47 "
Corn silage,	16.03 "	.....	27.38 "	24.79 "	15.97 "	25.26 "	29.84 "
Cost of gain per cwt., 1, 2, 3,	$12.40	$14.23	$9.88	$11.06	$11.27	$10.16	$9.50
	11.61	13.05	9.61	10.52	10.89	9.80	9.60
	10.99	11.88	.....	10.24	10.70	9.70	8.85
Necessary selling price, 1, 2, 3,	$7.47	$8.00	$6.82	7.08	7.05	6.86	6.61
	7.24	7.67	6.74	6.93	6.96	6.76	6.47
	7.07	7.34	.....	6.86	6.90	6.73	6.43
Actual selling price,	8.25	8.25	8.35	8.10	8.10	8.25	8.10
Profit per steer:							
Including pork,	17.07	8.24	26.21	19.43	19.86	21.54	24.16
Not including pork,	10.49	3.37	20.96	13.59	13.73	18.84	19.66
Pork produced from droppings,	1,198 lbs.	907 lbs.	957 lbs.	1,032 lbs.	1,070 lbs.	1,015 lbs.	880 lbs.
Corn fed to hogs in lots,	2,096 "	2,096 "	2,096 "	2,096 "	2,096 "	2,096 "	2,244 "

These figures are based upon the following prices for feeds:
Shelled corn, 1st mo., 15.7c., 2nd mo., 51.7c., 3rd mo., 57.1c., 4th mo., 58.5c., 5th mo., 64.2c , last ten days 71.2c.; cotton-seed meal, $29.00 per ton.
1. Clover hay, $20.00 per ton, Oat straw, $8.00 per ton, Corn silage, $4.00 per ton.
2. Clover hay, $15.00 per ton. Oat straw, $6.00 per ton, Corn silage $3.50 per ton.
3. Clover hay, $10.00 per ton, Oat straw, $4.00 per ton, Corn silage, $3.50.

Corn Silage Versus Clover Hay for Fattening Beef Steers*

That silage is an acceptable and profitable roughage for fattening steers our experiments clearly show. In 1910 our trials demonstrated that among other things:

1. Silage is a superior roughage for fattening cattle, being better than clover at average existent prices.

2. Silage is pre-eminently adapted to the short feed.

3. That in order to be most efficient a ration of silage and corn must be supplemented with cottonseed meal to the extent of 2½ to 3 pounds per 1000 pounds of live weight, daily. If clover is fed in addition to the above ration the cottonseed meal may be decreased one-fourth to one-third pounds per 1000 pounds live weight.

4. Cottonseed meal added to a ration of shelled corn, silage and clover during the last two months of a five months feeding period was not sufficient. Cottonseed meal must be fed the entire period for optimum results. The gains are increased at a decreased cost per unit and the steers sell for a higher price, because of the beneficial effects of the cottonseed meal.

5. Clover added to a ration of corn silage and cottonseed meal, tends to increase the selling price of the cattle. This advantage is offset, however, by an increase in the cost of gains.

6. Indications are that corn silage should be decreased in amount toward the end of the feeding period in order to permit the cattle to consume sufficient grain to furnish the necessary nutrients.

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*By J. M. Evvard and W. J. Kennedy.

7. Silage is practically two-fifths as valuable as clover hay for beef production. In other words, when clover is selling for $10 and $15 per ton, silage is worth $4 and $6.

8. Hogs following silage fed cattle secure some of the silage corn in the droppings.

9. Silage fed cattle are not necessarily heavy shrinkers at shipping time.

The general summary of the experiment follows by lots:

RESUME 1910-1911 STEER FEEDING

Record, Nov. 22-April 21, 150 days. Ten steers in a lot.

	Lot 1. Shelled corn, cottonseed meal, clover.	Lot 2. Shelled corn, cottonseed meal—last 60 days only, clover, silage.	Lot 3. Shelled corn, clover, cotton-seed meal, silage.	Lot 4. Shelled corn, cottonseed meal, silage.
Initial weight,	977.8	1,008	988.7	993.6
Final weight,	1,370.0	1,302.6	1,522.3	1,362.2
Total gain per steer,	392.2	294.6	533.6	368.6
Average daily gain,	2.61	1.96	2.22	2.45
Average daily feed eaten:				
Shelled corn,	19.24	14.58	14.07	14.99
Cotton-seed meal,	2.07	.88	2.54	3.51
Clover hay,	10.83	6.65	4.35	.....
Corn silage,	.....	18.45	23.86	30.15
Feed required per pound gain:				
Shelled corn,	7.36	7.42	6.33	6.08
Cotton-seed meal,	.79	.45	1.14	1.34
Clover hay,	4.14	3.39	1.96	.....
Corn silage,	.....	9.39	10.73	12.27
Cost per 100 lbs. gain, excluding pork profits,	7.91	8.26	7.99	7.32
Profit returned by hogs at $6.00 per cwt. for each 100 lbs. gain on steers,	1.47	1.44	1.53	1.55
Net cost per pound (including pork profits), gain on steers,	6.44	6.82	6.46	5.77
Total pork produced per lot,	1,497	1,243	1,386	1,490
Pork produced for each 100 lbs. shelled corn fed steers disregarding extra feed which was same in all lots,	5.187	5.683	5.565	6.653
Initial cost of feeds in lots per cwt.,	5.50	5.50	5.50	5.50

The valuations for corn, cottonseed meal and clover hay were based upon the current valuations during the progress of the experiment. They are:

Shelled corn, 36 cents per bushel.

Cottonseed meal, $28.00 per ton.

Clover hay, $10.00 per ton.

Corn silage, $2.50 per ton.

1910-11 Results Iowa Station.

	Lot 1. Shelled corn, cottonseed meal, clover.	Lot 4. Shelled corn, cottonseed meal, silage.
First 90 Days.		
Average daily gain,	2.80	3.11
Cost per 100 lbs.,	$7.15	$5.84
First 120 Days.		
Average daily gain,	2.66	2.68
Cost per 100 lbs.,	$7.84	$6.12
Entire Period, 150 Days.		
Average daily gain,	2.61	2.45
Cost per 100 lbs.,	$7.91	$7.32

The cost of silage is figured in the above tables at $2.50 per ton, but actually this silage cost this station $1.92. The corn from which the silage was made yielded fifteen tons per acre and was bought in the field at 8 cents below the market price of .36. It husked 60 bushel of shelled corn to the acre. The corn in the field was valued at 8 cents below the market price, because it will take 5 cents to husk and crib it and 3 cents to haul it to town. Hence, when corn on the average Iowa market sells for $0.36 per bushel it is worth in the field practically $0.28 per bushel. At this rate the silage corn standing in the field will yield 15 tons to the acre and the cost would be $1.19 per ton in the stalk. It cost $0.73 per ton to cut this corn and put it into the silo. This added to the original cost of $1.19 in the field, makes a total of $1.92 per ton. This cost includes the wear and tear on the silage machinery, the labor, twine, corn binder, etc. The total cost of $1.92 per ton, however, does not include the cost of the silo, and its depreciation. Hence, it will be seen that the value of $2.50 per ton, really allows $0.58 more than actual cost of the silage, which would be more than sufficient to allow for the depreciation and interest in the investment.

DEVELOPMENTS IN 1911 TEST

We draw the following from our results and observations this year:

1. To insure maximum consumption of silage early in the feeding period, the grain had best be somewhat limited. It is found that a maximum consumption of silage early in the feeding period is quite desirable.

2. To encourage quick and economical finishing, the silage is best decreased somewhat at the close of the feeding period and the grain increased accordingly. Cattle have a tendency to eat too much of the bulky, watery silage at the close of the feeding period for optimum results, leaving too little room for concentrated grains, a consumption of which is highly imperative at this time.

3. Silage alone in connection with a grain ration of corn and cottonseed meal, is superior , at average prices, to clover and the same grain ration. Silage at $3.20 a ton, was more profitable than clover hay at $10. In order to have broken even with the silage lot, the clover hay in this experiment should have cost not more than $7.66 a ton. Silage again proves to be worth practically two-fifths as much as clover hay for beef production.

4. The addition of clover hay to a ration of corn, cottonseed meal and corn silage does not materially alter the profits. When clover is comparatively low in price its addition is advisable, but where opposite conditions prevail, it may profitably be left out.

5. The shrinkage on the cattle receiving both clover and silage as a roughness, was least of any of the lots. This year's shrinkage practically coincides with the shipping result of 1910, showing clearly that silage fed cattle actually shrink less than clover fed ones, when either is used as a lone roughage and that each is individually outclassed by the combination of the two.

The allotment and rations fed in 1911 follows:

Lot I.—Shelled corn, C. S. meal, clover hay.

Lot II.—Shelled corn, C. S. meal, clover hay, corn silage.

Lot III.—Shelled corn, C. S. meal, corn silage.

These lots (I, II and III), were all put upon a full feed of grain in 40 days.

Lot IV.—Shelled corn, C. S. meal, corn silage.

Lot V.—Shelled corn, C. S. meal, corn silage.

The two lots IV and V, were handled identically the same the first 90 days; silage fed heavily and shelled corn increased to full feed in the 90 days; first months of thirty days, 6.44 pounds, second, 10.48; and third 14.97 pounds. Beginning 91st day, Lot IV was allowed corn and silage according to appetite, while Lot V was held back on silage and shoved hard on corn, the object being to get the ration concentrated at end of the fattening period. Cottonseed meal allowed in equal amounts of practically $2\frac{3}{4}$ pounds daily to Lots II to V. Lot 1, because of clover, which is rich in protein, was fed somewhat less for optimum results.

All feeds were charged at market prices as follows:

Shelled corn, first months, 50 cents; second, 51; third, 55; fourth, 57; and fifth, 65 cents.

Cottonseed meal, $28.00 per ton.

Clover hay, $15.00 a ton.

Corn silage, $3.20 a ton.

The silage cost is based upon the actual value of corn in the field, 8 cents below market, at time of siloing. Cost of filling silo, storage of silage and depreciation of equipment included. This allows the farmer a field profit on his corn grown. The actual production cost on this silage would not exceed $2.40 a ton.

All roughage fed twice daily, according to steer's appetite, excepting in Lot V, last two months.

The record of feed, gains, costs and profits follow by lots for the entire feeding period of 150 days, November 23, 1911, to April 21, 1912.

ANIMAL HUSBANDRY, RESULTS FROM IOWA EXPERIMENT STATION
TEN TWO YEAR OLD STEERS IN EACH LOT

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.
Average initial weight,	940	943	919	920.6	922.8
Average final weight,	1,299.7	1,299	1,261.3	1,246	1,257
Average gain per steer,	359.7	356.1	342.2	325.3	334.1
Average daily gain,	2.398	2.373	2.281	2 169	2.223
Average feed eaten per steer daily (pounds):					
Shelled corn,	20.20	16.95	15.60	13.71	14.64
Cotton-seed meal,	2.28	3.08	3.08	3.08	3.08
Clover,	9.02	3.90	None	None	None
Silage,	None	22.35	27.10	30.81	28.62
Feed required for a pound gain (pounds):					
Shelled corn,	8.42	7.14	6.84	6.32	6.57
Cotton-seed meal,	.95	1.29	1.35	1.42	1.38
Clover,	3.76	1.65	None	None	None
Silage,	None	9.41	11.88	14.21	12.85
Cost of a hundred pounds gain (excluding hogs),	$12.63	$11.77	$10.65	$10.74	$10.72
Profit returned by hogs for every hundred pounds gain on steers,	1.80	2.15	1.55	1.66	1.91
Net cost of a hundred pounds gain on steers, deducting hog profit,	$10.83	$9.62	$9.10	$9.08	$8.81
Necessary selling price a cwt. at Ames to break even (excluding hogs),	6.86	6.60	6.28	6.23	6.27
Necessary selling price (including hog profits),	6.36	6.01	5.86	5.80	5.75
Actual selling price* at Ames, deducting cost of shipment and shrink from Chicago values,	7.69	7.72	7.61	7.60	7.62
Net profit on each hundred pounds of steer (home final weights),	1.33	1.71	1.75	1.80	1.87
Net profit on each steer,	$17.27	$22.22	$22.03	$22.40	$23.46

*Chicago values are Lot 1, $8.20; Lot 2, $8.15; Lot 3, 4 and 5, $8.10.

SHRINKAGE IN TRANSIT

By Lots.

(Average for the Ten Steers)

	Lot 1.	Lot 2.	Lot 3.	Lot 4.	Lot 5.
Final home weight,	1,299.7	1,299	1,261.3	1,246	1,257
Chicago selling weight,	1,265.0	1,278	1,230.0	1,214	1,228
Pounds shrink per steer,	34.7	21.0	31.3	32.0	29.0
Per cent. shrink,	2.669	1.617	2.482	2.568	2.307
Cost of marketing, counting cost of shipment and shrink, per cwt.,	51c	48c	49c	50c	48c

It is gratifying to the friends of silage, its feeders, to know that the Iowa Station's results again show that silage fed cattle are not heavy shrinkers. This year they all under-shrank clover. Last year the least shrinkage was secured on those cattle fed both silage and clover. The light shrinkage of the cattle last year as well as this, would indicate that the manner of handling before shipping would be of interest.

These cattle were fed on timothy hay the last five feeds, the silage being continued in the ration, though lightly, until the last feed, when it was admitted. Oats were added to the shelled corn and cottonseed meal ration to the extent of one-half. The cottonseed meal was decreased to a pound to the steer. The car racks were filled with hay upon loading. The last evening before shipment, the steers were allowed about one-half of the amount of water they wished. That this method of shipping is satisfactory, the two years' trial indicates quite markedly.

In 1910 the Iowa Station called attention to the indicated possibility of feeding silage heavy in the early part of the feeding period, decreasing somewhat toward the finish when the animal became quite fat. It is somewhat interesting to note that Lot V, handled in this manner, heavy silage and light corn at the beginning with light silage and heavy corn at the finish, returned the largest profit per head, or 23.46, this in spite of the fact that corn increased to 57 and 65 cents during the last two months, as compared to 50, 51 and 55 the first three. In other words, everything was against this lot, because of the high price of corn, but nevertheless, it won out by a narrow margin.

In making this recommended change in the ration at the finish, it is advisable to do it very gradually, pushing heavily upon the corn and coming back gradually upon the silage. A decrease in the silage of from 10 to 25 per centum less than the appetite calls for, will be found satisfactory.

The value of silage for a short feeding period, is again abundantly demonstrated, in that the silage fed cattle in Lot III, as compared to Lots I and II, receiving respectively clover and clover-silage, made the cheapest and largest average daily gain during the first three months of the test.

Iowa farmers are building silos at an unprecedented rate. They are realizing before all things else, that the silo is indispensable upon the livestock farm. The most eloquent friends the silo has in this State are those who have tried it out, and have not found it wanting. Certainly these signs of current times are banner recommendations for such a feed as corn silage.

ILLINOIS EXPERIMENTS*

Subject: Fattening Two-year-old Steers.

Object: To determine the relative efficiency of various combinations of broken ear corn, cottonseed meal, silage, alfalfa hay clover hay and corn stover, as measured by the rapidity and economy of gains and finish produced on two-year-old steers fed in dry lot during the winter of 1910-11.

Plan: To select steers of uniform age, quality, condition, weight, and breeding and divide into uniform lots of ten steers each and feed the following rations:

Lot 1—Broken ear corn, cottonseed meal, silage and alfalfa.

Lot 2—Broken ear corn, cottonseed meal, silage and clover.

Lot 3—Broken ear corn, cottonseed meal, silage and corn stover.

Lot 4—Broken ear corn, silage and alfalfa.

Lot 5—Broken ear corn, cottonseed meal and silage.

Lot 6—Broken ear corn, cottonseed meal and alfalfa.

Lot 7—Broken ear corn, silage and clover.

Method of Feeding: Cattle were fed twice daily. All feeds except hay and corn stover were fed in bunks in open lot, hay and stover were fed in mangers under shed. Corn and cottonseed meal were fed first and after they were fairly well cleaned up the roughages were fed.

Time of Experiment: Experiment started November 19, 1910 and continued 143 days.

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*By H. P. Rusk.

Animals Used: Seventy head of medium to good two-year-olds, of mixed breeding. About two-thirds of these came from southern Indiana, while the other third came from Kansas City. Enough hogs were placed in each lot to make economical use of the droppings and were not fed extra.

Lots, Shelter and Water: Each lot of steers were fed in a 36 x 48 foot paved enclosure with a 12 x 36 foot open shed on the north of the inclosure. Water was supplied from the University water plant in galvanized iron tanks.

1910-1911 WINTER FEEDING RESULTS—143 DAYS

Rations.	B. E. C., S. S. M., silage alfalfa.	B. E. C., C. S. M., silage clover.	B. E. C., C. S. M., silage stover.	B. E. C., silage, alfalfa.	B. E. C., C. S. M., silage.	B. E. C., C. S. M., alfalfa.	B. E. C., silage, clover.
Initial weights,	9,410	9,445	9,280	9,430	9,140	9,135	9,225
Final weights,	12,945	12,560	12,565	12,795	12,850	13,260	12,210
Total gain,	3,535	3,115	3,285	3,365	3,710	4,125	2,985
Average daily gain,	2.47	2.18	2.30	2.35	2.59	2.88	2.09
Corn,	15,284	15,351	16,205	16.281	16.130	19,425	16,242
Cotton-seed meal,	2,253	2,263	2,708	.....	2.805	1.205	.....
Silage.	25.418	25.700	24.900	24,452	3,014	.....	25,622
Alfalfa,	3.195	.....	.....	4.136	.....	9.375	.....
Clover,	.....	2.102	.....	.....	.....	.....	2.005
Stover,	.....	.....	2.356	.....	.....	.....	.....
Cost of gains,*	$7.611	$7.439	$7.061	$6.470	$6.450	$7.063	$6.34
Pork produced,	446	438	448	461	418	505	356
Neeessary selling price,	$5.64	$5.53	$5.46	$5.31	$5.34	$5.57	$5.25
N. S. P. pork included,	5.43	5.33	5.25	5.09	5.15	5.34	5.08
Chicago value,	6.00	5.85	5.85	5.85	5.95	6.10	5.85
Value in lots without shrink,†	5.53	5.38	5.38	5.38	5.48	5.63	5.38
Profit per lot,	13.94	7.54	16.33	37.11	42.41	38.15	36.63

*Based on the following prices:
†Forty-seven cents per cwt. was allowed for shipping.
Corn, 40c per bushel: Alfalfa, $16.00 per ton; Cotton-seed meal, $30.00 per ton; Clover, $12.00 per ton; Stover, $3.00 per ton; silage, $2.20 per ton.

Summary 1910-11

1. The addition of alfalfa, clover or corn stover to a ration of broken ear corn, cottonseed meal and corn silage, decreased the rate of gains, increased the cost of gains and reduced the profits derived from the feeding operation.

2. The addition of cottonseed meal to a ration of broken ear corn silage and alfalfa, increased the rate and cost of gains and reduced the profits.

3. The addition of cottonseed meal to a ration of broken ear corn, and silage, produced more rapid gains, a higher finish and more profits than the addition of alfalfa to the same ration.

4 When fed with broken ear corn and cottonseed meal, alfalfa produced more rapid gains and a higher finish than corn silage, but the silage produced cheaper gains and yielded the greater profit.

5. When fed with broken ear corn and silage, alfalfa produced slightly more rapid gains than clover hay, but there was no material differences in the cost of gains and the finish produced or the profits derived from the feeding operation.

6. The shrink on all of these lots in shipping was heavy, hence the large charge for shipping expenses, which includes shrink, freight, yardage, feed and commission.

Winter, 1911-12

Subject: Fattening Two-year-old Steers.

Object: To determine the efficiency of various combinations of broken ear corn, shelled corn, C. S. M., silage and alfalfa hay as measured by the rapidity and economy of gains and the marketable finish produced on long yearling steers fed in dry lot during the winter of 1911-12.

Plan: To select steers of uniform age, quality, condition, weight and breeding, and divide into uniform lots of ten steers each and feed the following rations:

Lot 1—Shelled corn, C. S. M., and silage.

Lot 2—Broken ear corn, C. S. M., and silage.

Lot 3—Broken ear corn, C. S. M, and silage, first half; alfalfa, second half

Lot 4—Broken ear corn, silage (maximum) and alfalfa ad lib.

Lot 5—Broken ear corn, silage (medium) and alfalfa ad lib.

Lot 6—Broken ear corn, silage (minimum) and alfalfa ad lib.

Lot 7—Broken ear corn, silage and alfalfa ad lib.

Method of Feeding: Cattle were fed at regular intervals twice daily. All feeds except hay were fed in bunks in open lot, hay was fed in mangers under shed. The corn was fed first, and after the corn was fairly well cleaned up, the roughage was fed. Lots 1, 2, 3 and 4, received as much silage as they would clean up readily after they had consumed their full allowance of corn. Lot 5 received two-thirds and Lot 6 one-third as much silage as Lot 4. Alfalfa hay was fed ad libitum.

Time of Experiment: Experiment was started November 18, 1911, and continued to April 17, 1912—150 days.

Animals Used: 70 head of choice high grade Hereford steers. These steers are Wyoming bred steers (V. R's.) and were pastured in Kansas during the summer of 1911. Enough hogs were placed in each lot to make economical use of the droppings and were not fed anything extra.

Lots, Shelter and Water: Each lot of steers were fed in a 36 x 48 paved inclosure with a 12x 36 foot open shed on the north of the inclosure for shelter. Water was supplied from the University water plant in galvanized iron tanks which are protected from the weather by wooden jackets between which and the tank manure was placed during extremely cold weather to prevent freezing.

1911-12 WINTER FEEDING RESULTS—150 DAYS

	S. C., C. S. M., silage.	B. E. C., C. S. M., silage.	E. E. C., C. S. M., silage, alfalfa.	B. E. C., silage, alfalfa.	B. E. C., silage, two-thirds alfalfa.	B. E. C., silage, one-third alfalfa.	B. E. C., alfalfa.
Initial weight,	8,960	8,965	8,870	8,940	8,990	8,950	9,065
Final weight,	11,950	11,766.6	11,465	11,648.3	11,990	12,221.6	12,100
Total gain,	2,990	2,801.6	2,595	2,708.3	3,000	3,271.6	3,035
Average daily gain,	1.993	1.867	1.73	1.805	2.000	2.181	2.023
Average daily ration:							
Corn,	12.053	14.065	14.265	14.253	15.532	16.658	16.68
Cotton-seed meal,	1.525	2.394	2.274[1]	.....	.....	.....	.....
Silage,	27.728	23.706	22.72[2]	22.175	14.872	7.43	.....
Alfalfa,	.....	.....	7.49[3]	2.429	4.927	7.827	10.606
Cost of gains,	$9.392	$9.952	10.60[3]	$9.331	$9.358	$9.519	$10,788
Pork produced,	444	420	326	432	448	421	349
Necessary selling price,*	$6.77	6.86	6.96	6.69	6.77	6.86	7.12
N. S. P., pork included,	6.49	6.59	6.75	6.41	6.48	6.61	6.90
Value in lots (without shrink),†	$7.75	7.30	7.45	7.15	7.45	7.65	7.55
Profit,	150.57	83.54	80.25	86.19	116.30	127.10	78.65

[1] 91 days.
[2] 105 days.
[3] 69 days.
*Based on following prices for feeds: Corn, 56c; C. S. M., $30.00; Silage, $3.16; Alfalfa, $16.00.
†35c per cwt. deducted from valuations, on basis of Chicago market.

SUMMARY FOR FIRST 150 DAYS OF 1911-12

Cattle Feeding Experiment

1. When the entire roughage consisted of corn silage, shelled corn produced more rapid gains and a higher finish and returned a larger profit than broken ear corn.

2. The change from corn silage to alfalfa hay in the middle of the feeding period did not give satisfactory results, but the results secured in Lot 3 are not considered normal nor conclusive.

3. When fed with broken ear corn and corn silage, cottonseed meal produced a slightly higher rate of gain and a better finish than alfalfa hay.

4. In a ration of broken ear corn, alfalfa hay and corn silage, the larger the proportion of alfalfa hay to corn silage, the more rapid were the gains, the higher the finish and the greater the profits.

5. When properly supplemented with cottonseed meal, corn silage made cheaper gains than alfalfa, but did not produce as valuable a finish.

6. These cattle were fed another week and sold on the Chicago market at prices averaging 56 per cwt., higher than the average of the appraised value on the basis of the same market at the close of the 150 day period This increased the profits from $50 to $70 per lot. The final figures on the entire experiment are not available at the present time but they will show practically the same relative differences in profits that are shown in the results for the first 150 days.

INFLUENCE OF COST OF FEEDS ON PROFITS, 1911-12

FIRST 150 DAYS

Corn 56c., C. S. M. $30.00 per T., Silage $3.16 per T., Alfalfa $16.00

	1.	2.	3.	4.	5.	6.	7.
Cost of feeds, ...	$280.85	$278.83	$275.28	$252.73	$280.76	$311.44	$327.43
Cost of gains, ...	9.39	9.96	10.61	9.33	9.358	9.519	10.788
N. S. P. pork included, ..	6.48	6.59	6.75	6.41	6.48	6.51	6.90
Actual value, ...	7.75	7.30	7.45	7.15	7.45	7.65	7.55
Profit, ...	$150.57	$83.54	$80.25	$86.19	$116.30	$127.10	$78.65

FIRST 150 DAYS

(Corn 56.5c., C. S. M. $28.00, Silage $3.16, Alfalfa $20.00)

	1.	2.	3.	4.	5.	6.	7.
Cost of feeds, ...	$274.12	$271.59	$280.12	$256.73	$293.98	$335.09	$361.03
Cost of gains, ...	9.16	9.69	10.79	9.47	9.79	10.24	11.89
N. S. P. pork included,..	6.44	6.53	6.79	6.45	6.79	6.80	7.18
Actual value, ...	7.75	7.30	7.45	7.15	7.45	7.65	7.55
Profit, ...	$157.74	$90.60	$75.67	$81.54	$79.14	$103.88	$44.77

CHAPTER XIII

SHOW STEERS

The production of show steers is the highest art of the cattle-feeder. In order to be successful, it is necessary to produce cattle that are ideal from a butcher's standpoint. There can be no marked departure from the beef type; a slight deficiency which would not materially detract from the value of a market animal will eliminate him from the ranks of show animals. The show steer must be blocky, thick, smooth and compact. He must have light offal in proportion to live weight; be evenly and deeply covered with flesh and fat; possess style, finish and character; give every evidence of yielding a firm, smooth carcass with a minimum of low-priced and a maximum of more valuable cuts of thick marbled beef. The feeding of show steers demands a greater variety in their rations, better preparation of feeds and a study of the individual preference of each animal for feeds that will appeal to the appetite. In addition, the stockman must be prepared to shelter show animals from all unfavorable influences, such as flies and heat during the summer and extreme cold during the winter. He must also wash and groom regularly every day, in order that they may be presented in the most attractive form in the show ring.

The International Livestock Exposition held in Chicago, Illinois, during the first week in December of each year brings together the greatest lot of show steers assembled in one body throughout the world. The winners in this competition set the standard of breeds and types throughout the United States and Canada. While the majority of championship winners in single steer competitions are pure-bred Aberdeen-Angus, Herefords or Shorthorns, grade steers representing these three breeds occasionally win highest honors as shown by the following exhibit:

GRAND CHAMPION SINGLE STEER AWARDS

Year.	Breed.	Price per lb.	Name of Animal.	Name of Exhibitor.
1900,...	Aberdeen-Angus, ...	$1.50	Advance, ...	S. P. Pierce.
1901,...	Hereford, ...	50	Wood's Principal, ...	G. P. Henry.
1902,...	Aberdeen-Angus, ...	56	Shamrock, ...	Iowa State College.
1903,...	Hereford (grade), ...	26	Challenger, ...	Univ. of Nebraska.
1904,...	Aberdeen-Angus, ...	36	Clear Lake Jute 2d, ...	Univ. of Minnesota.
1905,...	Aberdeen-Angus (grade), ..	25	Black Rock, ...	Iowa State College.
1906,...	Hereford, ...	Not sold	Peerless Wilton 39th Defender.	F. A. Nave.
1907,...	Shorthorn (grade), ...	24	Roan King, ...	Jas. Leask.
1908,...	Aberdeen-Angus, ...	26½	Fyvie Knight, ...	Perdue University.
1909,...	Aberdeen-Angus, ...	18	King Ellsworth, ...	Kansas State College.
1910,...	Aberdeen-Angus, ...	60	Shamrock 2d, ...	Iowa State College.
1911,...	Aberdeen-Angus, ...	90	Victor, ...	Iowa State College.
1912,...	Aberdeen-Angus, ...	50	Glencarnock, ...	J. B. McGregor.
1913,...	Aberdeen-Angus, ...	Not sold	Glencarnock 2nd, ...	J. B. McGregor.
1916,...	Cross-Bred, ...	1.75	California Favorite, ...	Univ. of California.

While the individual competition represents the best efforts of breeders and the highest possible type of individual excellence in beef cattle, the interesting feature of the International to producers and feeders of market animals is the car lot show in which groups of fifteen animals fed and exhibited by men who make a business of finishing steers for the block. These steers are generally produced and fed under normal conditions. The farm equipment necessary for their production does not differ materially from that found in practical feed lots. The feeds used are usually grown on the farms where the cattle are developed and supplemented with commercial nitrogenous concentrates. This exhibit indicates to the farmer the possibility of a combination of breeding and feeding in the improvement of market cattle in contrast with average run of beef on the central markets, the majority of which shows no evidence of the use either of good breeding stock or profitable methods of feeding. In the following exhibit, the breeding, selling value and ownership is given for the cattle which have won the Grand Championship in the car-lot competition at the International Livestock Exposition for the past eleven years:

Year.	Breed.	Price per lb.	Name of Exhibitor.
1900,.....	Aberdeen-Angus, ...	$15.50	L. H. Kerrick.
1901,.....	Hereford, ...	12.00	D. W. Black.
1902,.....	Aberdeen-Angus, ...	14.50	Chas. Esher.
1903,.....	Hereford, ...	8.35	W. F. Herrin.
1904,.....	Aberdeen-Angus, ...	10.00	Claus Krambeck.
1905,.....	Aberdeen-Angus, ...	8.65	Claus Krambeck.
1906,.....	Aberdeen-Angus, ...	17.00	Funk Bros.
1907,.....	Aberdeen-Angus, ...	8.00	Claus Krambeck.
1908,.....	Aberdeen-Angus, ...	11.00	Funk Bros.
1909,.....	Shorthorn, ...	15.00	Keays & Oglesby.
1910,.....	Aberdeen-Angus, ...	13.50	E. P. Hall.
1911,.....	Aberdeen-Angus, ...	15.75	Escher & Bryan.

The Grand Championship has been won by Aberdeen-Angus cattle nine times, Herefords twice and Shorthorns once. The highest price paid was $17.00 and the lowest $8.00, with an average of $12.13 for the eleven years. One exhibitor has won the highest honors three

†The highest priced car-load of cattle ever sold were the Angus of Chas. Escher & Son, winners at Pittsburgh show in 1901. They sold at $21.50 per cwt. to the Pittsburg Provision and Packing Company.

times, and one twice. During the seven remaining years, it has been won by different parties. During all of this time, the majority of championship carloads have been bred and fed on the farms of the exhibitors, which indicates that in order to secure uniform excellence in a carload of beef cattle, it is much easier to breed than to purchase them.

While the prices for Grand Championship cattle are somewhat above the average of all entries, the following exhibit shows that the demand for finished beef causes all show cattle to bring prices that justify the feeders in carrying them to an extremely high degree of condition when they possess the quality and type necessary to classify as show cattle. These prices are but slightly under top price for market cattle at the same season of the year, and in several years less than prevailing prices during preceding months.

AVERAGE PRICE OF CARLOADS OF FAT CATTLE AT AUCTION DURING THE FIRST WEEK OF DECEMBER AT THE INTERNATIONAL LIVESTOCK EXPOSITION

	Aberdeen-Angus.	Hereford.	Shorthorn.	Galloway.
1900,	$7 29	$6 29	$6 25	$6 45
1901,	8 22	8 23	7 74	.....
1902,	7 64	7 43	7 45	.....
1903,	5 90	5 99	5 61	6 05
1904,	8 20	7 29	7 42	.....
1905,	6 71	6 52	6 70	6 80
1906,	8 53	7 90	7 84	7 75
1907,	6 66	6 37	6 40	6 51
1908,	9 53	8 84	8 51	8 00
1909,	11 98	10 45	11 24	.....
1910,	8 58	7 86	8 10	7 80
1911,	11 37	10 92	10 68	10 75

The preceding table shows that the production of beef cattle and finishing them for market is usually quite profitable. In this connection a careful study of the prices usually paid for pure-bred breeding stock may be useful.

FITTING CATTLE FOR THE FAT STOCK SHOW*

In fitting cattle for a fat stock show, there are a great many things that we must consider, if we expect to be successful. One very important thing for the man who expects to engage in this business, is for him to be sure that he has a correct idea of what a perfect type of a beef animal should look like. After he has this much of the problem settled, then he should look around among some of the best pure-bred herds of beef cattle. Good cattle can be found in all of the beef breeds, but I think we can come nearer finding a perfect beef animal in the Angus breed than in any of the others. I believe that the best plan for a man who expects to fit a steer or a load of steers for show is to breed them himself. The man who wins with the cattle he has bred and fed has gained knowledge from two sources. He has had a chance to study them from beginning to end.

We should not think that because some other fellow has been breeding or feeding prize winners all his life, there is no show for us. If we intend to breed the animal that we fit for show, then we should be very careful how we start. We should get the best pure blood it is possible for us to get, for prize winners do not come from scrub stock. We should breed the kind that mature early. An animal that is to be fitted for a show, must be fed liberally. The earlier he matures the more feed we will have and the less risk we will have. In fitting cattle for show, we must decide for ourselves whether or not we are capable of caring for them from start to finish. We should be fond of caring for animals. We should have plenty of patience, for there are times that will try our patience. It may be a case of fever, not an extra good appetite, or it may be that the animal is showing an unusual amount of contrariness and probably, if you stop and look around a bit, you will find it was not contrariness after all. A quick-tempered, hot-headed man has no business with this kind of an animal. Steers should be quietly handled at all times and we should be as affectionate towards them as possible.

After the animal has been selected that we intend to fit for show, then we should lose no time in making friends with it. It should be taught to lead as early as possible and one that cannot be taught to lead like a horse after a reasonable time should not have feed wasted on it. While there are many cattle fitted for the fat stock shows every

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*By C. L. Taggart, Washington, Pa.
Mr. Taggart is the only feeder who has twice won the Grand Championship for best carcass at the International Livestock Exposition.

year, yet it seems that every feeder that has made a champion steer, has done it with a ration different to that fed to other champions, and still we are without a standard feeding ration for making prize-winners. We are taught in political economy that land is the basis of all wealth, so that when we go to the bottom of the feed problem, we can say that the best of pure-bred beef cattle, and the grains, hay and fodder usually grown by the average farmer are the basis of all the Grand Champion beef cattle at the fat stock shows. A great deal might be written about the art of fitting cattle for show. Some of the most important parts of it to be considered are what to feed, when to feed, and where and how to feed. There are a great many feeds that may be given in connection with the feed that is always used, such as oil meal, roots, molasses, and the different kinds of stock foods. Many of these are no doubt a benefit to feeders in finishing cattle. We should study the general make-up of the animal we are feeding, his tendency to lay on fat, his preference for one kind of feed over another. The proportion of fat and protein given to one may not be quite right for some other one. One thing above all others that a feeder should be particular about is the quality of the feed given. A highly fed animal is very quick to detect any bad taste or odor in his feed. It should be of the very best quality, and kept in a good clean bin where rats and chickens are not allowed. The steers should have a little bit of salt every day, but not quite enough to satisfy them. Corn no doubt is considered the king of all feeds for fattening, but I am very much inclined to think we will have to get away from the habit of feeding so much corn if we want to make the finest quality of beef.

When to feed is a question on which some feeders differ a little. In my experience, I have found it best to feed at least three times a day; for the latter part of the feeding period I would prefer four times a day. If you decide to feed at 6-12-6, then it should be done at those hours if possible. No experienced engineer would feed his engine fuel an hour or two either before or after it needed it, and still expect it to do good work. Neither should an experienced feeder expect a steer to convert his feed into first-class beef and make rapid gains by varying his feeding hours. If the animal is taking just about all he can clean up, at each feed, we should not run into his stable in a hurry and feed him an hour or two before the regular feeding time. He will probably be slow about coming to his feed, and may not clean it up as he should because he was not quite ready for it. If we come in an hour or two later than usual, we have kept him waiting after he was ready, and this may cause uneasiness, and this is the opposite of what we should want. All kinds of stock soon learn to look for their feed at certain times, if they are in the habit of eating at those times.

The manner in which we feed is of great importance. The feed box should be off the ground in a place where the air can get all around it as much as possible. The inside should be very smooth, so that there will be no place for feed to collect and become sour and musty. Chickens and rats should not be allowed in the stable, for cattle dislike to eat out of a trough that they have been tramping in or roosting on. Feeding measures should also be kept clean, and there should be different sizes, so that as the feed is increased, it will not be done by guess work. We should know how many pounds each measure holds of the mixture we are feeding. By knowing this and having a set of scales handy, we can tell in a few minutes what it is costing to make this kind of beef.

Fat cattle use a large amount of water and they should have access to good running water at all times, and their trough should be cleaned often. The stable should be well bedded with wheat straw and kept clean and dry, and a disinfectant used occasionally. It should be on the sunny side of the barn, unless it is necessary to keep them away from flies. A shed 20 x 40 makes a nice size for them to stay in. It is also well to have a small yard out of doors to let them in often. Fat animals do not require much exercise, but they cannot be properly fitted without a little every day. Cattle that are being fitted for show should have a bath occasionally. By doing this and using a brush the hair and skin can be kept in good condition.

Fitting cattle for fat stock shows is one part of the cattle feeding business, that is not practiced much in Pennsylvania, and until fat stock shows become more numerous in our State and others, we need not expect to see any great improvement in the quality of cattle sent to the slaughter houses. No doubt there are many cattle fitted for show that do not win, but according to my notion, every man that feeds cattle should fit at least one steer for show. By doing this he can learn a great many things about the habits of cattle, that he never knew before. If the steer has been a right good one and yet does not win a dollar in premiums, the knowledge the feeder has gained, with regard to the habits of the animal and the effects of the feed used, will pay him for his trouble and the steer should be good enough to sell at an advance over cattle that have not been fitted for show.

A PURE-BRED HERD

The management of a herd of pure blood beef cattle certainly is a very interesting part of the livestock business, and I have never once regretted that I made a start in pure blood beef cattle. In the management of my herd, I have at times been somewhat perplexed with

regard to which are the best methods to follow in breeding and feeding cattle of this kind. Some of the noted breeders do not follow the same methods, so I think it is not a good idea to change our plans too often, but follow the one that suit our conditions best.

In my experience in breeding, I have fund that it will not do to pay too much attention to an animal's pedigree. It is all right to try to get a good pedigree with the animal we buy, but pedigree does not amount to a great deal if the individual is not right. In my experience the following methods have given good results. I have always aimed to have my cattle mature at as early an age as possible. This required good feeding and handling and close attention to business. From the time a calf is dropped up to 14 or 16 months of age, we are liberal with the feed and very careful in handling. If I want to make a show animal out of any of my cattle, it is in the early part of this period that I decide it. If at the end of this period, they do not come up to my expectation for showing or breeding, I can receive a fair price for them from the butcher. In a usual way my calves are allowed to run with the dam in the field, until they are 3 or 4 months old. During the first month or until the calf can take all the milk, they are both brought to a yard at the barn at night, and all the milk taken from the cow that the calf has not used. By doing this, we avoid caked udders and sick calves, besides it has a wonderful influence on the little calf to have it become acquainted with the family and the barn yard surroundings during the first months of its life.

I have calves come at different times of the year, but prefer to have most of them come about the first of June or soon after. The reason I follow this method, is because at this time of the year, we are more likely to have a good flow of milk than at any other time, and it is very important that the calf should have a good start. We may furnish the calf with feed later on, if milk is not as plentiful as it should be, but if they do not have plenty at the start, we must either feed the dam heavily or furnish a nurse cow. Either is expensive for the average breeder, as cheap grain seems to be a thing of the past. By having the calves come at this time of the year, the expense of keeping the dam is much less than it would be at any other time.

By the time the flow of milk begins to decrease, we manage to have a second crop of clover ready for pasture. When this is done, then a good blue grass pasture, and by this time and often sooner, the calf has learned to eat grain, and if milk is not so abundant now, we have a lever on them and push them along. The cow by this time, should be in good shape to go into winter and the calves weaned later on, if we wish, at a time when it is not easy to produce milk.

Calves that come at this time are not housed and pampered. They have freedom to romp around and become thrifty and robust, which is a necessity in breeding cattle. After the grass has been frosted

and often sooner, the calves are brought to the barn yard at night, and given grain and clover hay. Later on, they are kept in the yard all the time and allowed to nurse morning and evening, and are housed at night as winter approaches. If they have not had a chance to eat grain previous to this, it will probably take them a day or two to get at it right. Their shelter is under the south side of the barn, where they have access to water. They are usually started on whole corn or equal parts of corn, oats and bran and a few roots later on. After the calves have learned to eat well, I prefer to have the grain ground and the finer the better. Long yearlings and two year olds are not usually given quite so much attention, a light feed of grain with good hay or fodder and a shelter from the storm, will generally bring them through winter in good shape.

The herd bull has a yard of his own, and is kept there all the time, except at night in winter and very stormy days. He is fed enough to keep him in a good, thrifty condition all the time. He must have a good disposition and must not be abused and should be trusted very little. The more he is abused the less he can be trusted.

CHAPTER XIV

CATTLE BARNS

No man who is equipping his farm for the production of beef, should spend money for warm cattle barns. Barns of some kind are necessary to house feed, but they are not necessary for the well-doing of beef cattle, either in breeding or feeding herds. In fact the best cattle barn for dry cows, young stock and feeding steers is no barn at all, but a shed where the animals may have dry hides and protection from wind. A beef animal cares very little for rain or snow that comes straight down, but demands shelter from wind and rain or snow blown against it. Cows that calve in winter sometimes need a warmer place than a shed for a day or two, but not the warmth required by dairy cattle. However, Pennsylvania farmers have the biggest barns in the country, they have been educated for over one hundred years to believe in and use those warm barns and they are going to use them. For the benefit of those who have barns and prefer to use them in the old way in winter, this chapter is written in the hope that it will give some suggestions as to the proper use of the barn. But the cattle will be better off, if they are allowed to run in and out at will, and this applies to all cattle, including calves after they have been dried and got their little bellies full of warm mother's milk.

The things sought in a barn of any kind are the health and comfort of the animals, economy of construction and maintenance, and of feed and labor. Temperature, light and ventilation are three important considerations from the standpoint of the health and comfort of the animal. In order that the vital function be carried on it is essential that the temperature of the body of the animal be maintained within certain comparatively narrow limits; for mature cattle in health, this is usually from 101 to 103° F., regardless of the tem-

perature of the surrounding air. The animal itself has the power to control automatically its body temperature, under ordinary variations of temperature of the air. The animal through the oxidation of its food is constantly producing heat, the surplus of which is got rid of by radiation from the body and by the evaporation of moisture. As the temperature of the air rises the radiation and the evaporation increase and sometimes the consumption of food decreases. As the temperature of the air falls, the radiation and evaporation decrease and the consumption and digestion of food increases. It has been found that even a fasting animal is producing a surplus of heat which it must get rid of.

It is probable that there is a heat temperature at which an animal may be maintained on the minimum amount of feed consistent with the elimination of its surplus heat with the least discomfort. This, however, would not be necessarily the most economical temperature. The most economical temperature, varies with the class of animal, method of feeding and probably the humidity of the atmosphere. Dairy cattle require warmer stables than beef cattle, because they usually have a lighter coat of hair and are in thinner flesh. The most desirable temperature cannot be stated in degrees, as cows have the power of adapting themselves to cold quarters by gradually becoming accustomed to them in the fall.

LIGHT

The stable should always be as light as possible, for three reasons, viz: The health of the animals, the convenience of the attendant, the incentive to cleanliness. Animals are always more comfortable in light stables than in dark ones. Cows kept in dark stables and turned daily into bright sunlight, frequently have weak eyes and in old age may go blind. Sunlight is also known to be one of the greatest enemies of most disease germs, particularly the bacillus of tuberculosis.

Any man would rather work where he can see what he is doing. The difference in the amount of work a man can do in a light stable and a dark one is greater than might be supposed. The attendant is often ignorant of the accumulation of dirt and filth in dark stables. Where dirt is not seen it is apt not to be disturbed. There will always be a tendency to slight the work. The attendant can take no pride in keeping the cows clean or the stable in order.

WINDOWS

In closed stables the light must be admitted through windows. These should be vertical rather than horizontal for the reason that vertical windows will admit more light than horizontal ones of the same size, and will admit it nearer the floor, where it is most needed. The vertical windows will also leave more wall area to support the part above. The south side of the building is the most desirable for windows. The thicker the walls, the more and the larger the windows will need to be. If in a stone, brick, or cement wall, that part below should be beveled in order not to form a place for the accumulation of dirt and rubbish, that is desired to get rid of, and to admit more light near the floor. It is also well to bevel the sides, too, if the wall is thick.

VENTILATION

Many stables are open enough that special provision for ventilation is unnecessary. In the eastern part of the United States, however, and especially in Pennsylvania, where bank barns with basement stables, are common, particular attention must be given to ventilation. The better constructed the barn is, the greater the need for systematic ventilation. The necessity for ventilation is fundamental. The life process involves the consumption of oxygen and the production of carbon dioxide and other products which must be passed off into the air. Each respiration of the animal removes from the air a certain quantity of oxygen and adds about an equal quantity of carbon dioxide, besides the moisture, organic matter, etc. Notwithstanding the consumption of oxygen and the exhalation of carbon dioxide, recent experiments by Reynolds of the Minnesota Experiment Station* and by Atwater, indicate that within ordinary ranges this is not the chief cause of the need of ventilation. Normal air contains about .03 per cent. of carbon dioxide by volume and it has been held that it becomes "rapidly fatal if it exists in a larger proportion than 1. per cent." Reynolds says, "This seems absurd when we have had a Jersey steer getting fat in 2.67 per cent. carbon dioxide." A survey of the teachings on the subject (injurious effects of foul stable air), gives a reasonable conclusion that the popular impression concerning the general harmfulness of foul stable air may be in a general way, correct; but the explanations may be very gravely doubted."

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*Min. Bulletin, No. 98.

The following table from King's "Physics of Agriculture," gives the amount of air breathed and oxygen consumed in twenty-four hours:

	Animal weight.	Air breathed in 24 hours.	Oxygen consumed in 24 hours.
Man,	150	425	1.831
Horse,	1,000	3,401	13.272
Cow,	1,160	2,804	11.04
Hog,	150	1,103	4.456
Sheep,	100	726	2.931
Hen,	3	24.84	.075

Since a cubic foot of air weighs about .08 pounds, this would mean that a cow passes through her lungs 224.32 pounds of air in twenty-four hours. She consumes roughly speaking 30 pounds of feed and 70 pounds of water, less than half as much of these two as of air. Unless there is ventilation, the same air must be used over and over again. Assuming that the air of the stable should not contain more than 3.3 per cent. that has been once breathed, from the above table we find that the following amounts of fresh air should be furnished per head hourly:*

Horses,	4,296 cu. ft.
Cows,	3,542 cu. ft.
Hogs,	1,392 cu. ft.
Sheep,	917 cu. ft.
Hens,	31.4 cu. ft.

In addition to the kind and size of animal; the amount of oxygen consumed and carbon dioxide excreted, depends upon several other factors: "We have the lowest possible rate of respiratory change during fasting, something higher on a non-nitrogenous diet; higher still on a mixed diet and the highest degree of respiratory activity on a nitrogenous diet. The volumes of oxygen absorbed and CO^2 develped, increased rapidly until the increase of body temperature or physical activity. Muscular activity greatly increases the oxygen consumption. Physiologists tell us that even shivering multiplies the respiratory activity by two. External cold has a somewhat similar effect." Dr. Armsby has found by the respiration calorimeter at the Pennsylvania State College that the consumption of oxygen is about two-thirds as much in an animal lying down as in standing.

In the Year Book of the U. S. Department of Agriculture for 1904, Dr. Atwater states that their subjects remained in perfectly normal condition in an atmosphere containing eight to ten times the amount of CO^2 found in the open air.

While the decrease in oxygen and the increase in CO^2 within the limits found in ordinary stables may not in themselves be the cause of discomfort or lack of vigor, they are the most convenient measuring of the purity of the air. The presence of a high percentage of CO^2 for animal exhalation is always accompanied by a large amount of moisture, ammonia, marsh gas, and organic matter and great numbers of bacteria. All of these are more or less injurious.

*King's Physics of Agriculture.

It is known that contagious diseases, such as glanders and tuberculosis, spread more rapidly in poorly ventilated stables than in more open ones. It will be observed that all the experiments which show no injurious effects from poor ventilation are with single individuals, presumably in a perfect state of health and for the most part are for a comparatively short period.

MEANS OF VENTILATION

The natural causes which may be utilized to produce variation are the following:

1. The wind.

2. The diffusion of gases.

3. The variation in the weight of the air at different temperatures.

No barns have walls absolutely air tight, although there is great variation in this respect. There are always greater or less cracks about the windows and doors and a perceptible amount of air is admitted through unpainted boards, and soft brick laid in common lime mortar. The pressure of the wind on the windward side and the suction caused by the partial vacuum on the leeward side both tend to increase this circulation.

Gases tend to diffuse themselves indefinitely and form a uniform mixture. When the CO^2 and other gases are exhaled by the animal, they do not remain in the immediate vicinity of the individual exhaling them but tend to distribute themselves uniformly through the surrounding air. This is kept up indefinitely, the tendency being for the entire atmosphere of the earth to become a uniform mixture.

It is well known that warm air is lighter than cold, and so tends to rise, the cooler rushing in to fill its place. This is the cause of practically all winds and air currents and is the principle upon which the King system of ventilation is based.

METHODS OF VENTILATION

In any method of ventilation, the two things must be provided for, viz: The disposal of the impure air and the admission of the fresh. This may be accomplished through windows or through windows built for this special purpose. The change of air should be brought about without causing a draft on the animals so far as possible. Sometimes this may be done by opening ordinary windows in differ-

ent parts of the building. A better method is by use of the Sheringham window, which is hinged at the bottom and guarded at the sides. This window may be opened to any angle, and the guards at the sides prevent any air from entering except what comes over the top. This is deflected over the backs of the animals where it mixes with the warm air and gradually descends by the diffusion of gases.

The muslin window has come into use in the past few years and seems to give satisfactory results in many cases. This was first used by the poultrymen and has later been adopted to some extent by dairymen. This consists of a light wooden frame made to fit in the window frame in the place of the sash. Over this light frame is tacked common muslin rather loosely. The muslin allows a free circulation of air, but prevents strong drafts. The muslin should not be stretched tight, as it will not permit of good circulation. This contrivance has the merit of cheapness, convenience and adaptability. Its disadvantages are that it requires frequent renewal and cannot be regulated to any great extent.

THE KING SYSTEM

Probably the most satisfactory method of ventilating a well built barn is by means of what is known as the King system named for Prof. F. H. King of Wisconsin who first advocated its application to the ventilation of stables. The essentials of this system are the admission of fresh air near the ceiling and the removal of the used air from near the floor, both through flues.

The opening into the intake flue is near the ground on the outside of the stable. This should be protected by a strong netting to keep out rats, etc. The air fans up the flue and enters the stable near the ceiling as stated. These intake flues are sometimes built in the wall, sometimes inside the stable and occasionally on the outside. A number of small ones are better than a few large ones as the air is better distributed.

The outlet flues should be well within the stable rather than against the outside wall in order that they may not get cold and condense the moisture or check the draft. They should be as straight as possible, smooth inside, air tight and extend above the ridge of the barn or adjacent building to secure the greatest benefit. If necessary to carry the flue some distance above the roof, it should be pro-

tected to prevent the walls from getting so cold as to condence the moisture and cause dripping below. The cold walls will also check the draft and thus diminish the efficiency.

King states,* that "it is practicable to construct ventilation flues through which the air from stables will travel at the rate of 200 to 500 feet per minute without mechanical forcing or the aid of heat other than that derived from the animals in the stalls." "With a ventilating flue 2 x 2 feet inside 20 cows would be supplied when the current in the flue was 295 feet per minute."

In order to get the best results from the King system it is necessary that the stable be well built, with walls tight and doors and windows fitting closely. This would, of course, be when the ventilation was most needed, so that the efficiency of the King system is to some extent at least in proportion to the need of ventilation.

The outlet flue should have a register or slide near the ceiling that may be opened in warm weather to help cool the stable and sometimes to start the draft and set the system to working properly.

SIZE OF STABLES

Speaking apparently of dairy cows, King says, "Twenty cows should not be housed in a space much less than 28 x 33 feet with ceiling 8 feet in the clear. In the steer feeding work twelve steers have been fed each year in pens 20 x 20 feet and 20 x 23 feet exclusive of feeding alleys. Data is wanting as to beef cows, but these figures may furnish some indication of the amount of space required. About the same amount of floor room will be required whether the cows are tied up or run loose in pens. In either case box stalls will need to be provided for calving and separate pens for the calves."

Crowding is not conducive to the best health of the animals, but at the same time, larger buildings than necessary are an additional expense and increase the amount of unproductive capital.

THE BANK BARN

This form of barn so common in Pennsylvania has many advantages when properly constructed. It is convenient in that animals and feed are all under one cover. It is economical for the amount of space enclosed when cost of construction and repairs are both considered. It is not subject to sudden changes of temperature.

The objections to it are that unless special care is taken in planning and constructing it the stable is apt to be dark, damp, and poorly ventilated.

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*Physics of Agriculture.

The ideal location is a southern slope that is not too steep. The barn floor should be reached by a bridge in order to admit light on all sides and to keep the upper wall dry. The eaves should have gutters and the walls be well drained to keep the stable dry. There should be no "overshoot" to obstruct the light on the lower side. There should be some efficient means of ventilation.

ROUND BARNS

The ordinary form of barn is rectangular, about twice as long as wide. It is obvious that there are certain advantages in this form otherwise it would not be so common. The chief advantages seem to be that it is easy to build, and that every one is familiar with it. It readily lends itself to regular divisions into rectangular pens and stalls with no odd shaped corners.

The round barn has been advocated by many writers for some time, but is rather slow in coming into general use. Between these two extremes we have the square barn, the hexagonal, the octagonal, dodecagonal, etc. The round barn encloses the maximum amount of floor space for a given length of wall and the area diminishes as the number of sides decreases.

The following table shows the amount of floor space or area enclosed by barns of different forms having equal length of outside wall:

Form.	Dimensions.	Area or Floor Space. Sq. ft.
Rectangular,	40 x 80,	3200
Square,	60 x 60,	3600
Hexagonal (6 sides),	40 on a side,	4157
Octagonal (8 sides),	30 on a side,	4346
Dodecagonal (12 sides),	20 on a side,	4478
Round,	240 circum. 76 diam., 76 diam.....	4683

This table shows that the round barn contains 46 per cent. more floor space than the rectangular one whose length is twice its width and 30 per cent. more than the square one of the same length of wall.

To find the number of square feet of floor space in a barn of any of the above forms when one side is given, multiply the square of one side by the following factors:

For hexagonal,	2.598
For octagonal,	4.828
For dodecagonal,	11.196

For example: If a barn 30 x 60 feet is contemplated and it is wanted to know what floor space a twelve-sided barn with the same length of wall would enclose the following process would be used: A barn 30x60 feet would have 180 feet of wall; if this were divided into 12 equal sides each would be 15 feet. The square of fifteen (15 x 15) is 225, which multiplied by 11.196 gives 2519 the number of square feet in the twelve sided barn as apposed to 1800 square feet in the rectangular one.

To find the area of a round barn, divide one square of one-half the circumference by 3.1416; to find the diameter divide the circumference by 3.1416.

For example: In the above case the circumference is 180 feet, one-half of which is 90 and the square of 90 (90 x 90) is 8100; which divided by 3.1416 gives 2598, the area of the round barn, not greatly different from that of the dodecagonal one.

Less framing is required in the round barn than in the square or rectangular one because each part of the wall supports and braces every other part, just as a round tank or silo can have lighter walls than a square or rectangular one except that the pressure is on the outside. The wind pressure is much less on the round or many-sided barn because of the area on which it can be directly exerted.

The difficulties in the way of convenient internal arrangements of round barns are more imaginry than real. No one can be found who has built and used a round barn and who would like to go back to the old form. Where silos are used, and every one who raises or feeds cattle should have a silo, it usually occupies the center. Stalls, pens and feeding alleys may be arranged in a circle around it. Circular tracks may be had for manure and hay carriers if desired.

DEVICES AND INTERNAL ARRANGEMENTS

Cow barns should have as few contrivances, and these as simple in contrivance as consistent with the comfort of the animals and the convenience of the attendane. There is no saving in appliances that require more time to keep in order than would be required to do the work without them. The expense of installing and keeping in repair many of the stable devices is out of proportion to their usefulness, especially for beef cattle. Everything should be readily accessible and easily cleaned. The time will come when the stable must be disinfected and the more complicated the arrangement the greater the necessity, and the more difficult the operation.

FLOORS

Importance. One of the first questions which the builder of a cow barn will have to decide is the kind of floor he will have. The floor is important from the standpoint of cost, comfort, cleaning, saving manure, etc. Some of the essentials of a good floor are the following: (1) Imperviousness, (2) Ease of cleaning, (3) Durability, (4) Comfort, (5) Cheapness, (6) Healthfulness.

As it is impossible to obtain a high efficiency in all the points in any one material the builder must be guided by the conditions which confront him. Floors are usually made of clay, cinder, wood, or concrete.

Clay floors are cheapest in first cost and are comfortable and healthful if well drained, but they require frequent repairing if cleaned often, and are not impervious, permitting loss of part of the liquid manure. Cinder floors in many localities come next in cost, but are open to the same objections; although more durable, they are less impervious.

Macadam and cobblestones have been used but are not recommended because they are not comfortable unless an excessive amount of bedding is used: At the present price of lumber probably wood floors are about the most expensive. They also lack in durability, but are comfortable and healthful and can be made practically impervious.

Cement Floor. These have much to recommend them. They are impervious, durable, easily cleaned, and, if well bedded, are comfortable. The objections urged against them are that they are cold, and slippery and that their cost is too great for the benefits de-

rived. The validity of the first objection depends upon the amount of bedding used and whether the stables are cleaned each day. If the cows are kept loose in pens the latter need not be cleaned daily as it will save labor and preserve the manure in better condition if the animals are bedded down on it as long as possible. The second objection can be obviated by roughing the finishing coat. The importance of the third objection depends upon the cost of stone, sand and gravel

DIRECTIONS FOR LAYING CONCRETE FLOORS*

Excavate to ten inches or fifteen inches below the level of the finished floor, and put down six inches to twelve inches of porous material such as cinders or screened gravel. This should be carefully laid and tramped in layers. The better drained the soil the thinner may be this porous foundation. On this should be laid three to five inches of a 1 : 2½ : 5 mixture and finished with one inch mortar made of one part Portland cement to one and one-half part clean coarse sand.

The strength and hardness of concrete construction depends upon the proportion of the mixture and the quality of the sand. The finer the sand the more cement must be used. A 1 : 2½ : 5 mixture means one part cement, two and one-half parts sand, five parts loose stone or broken gravel. The following table gives the quantity of cement, sand and gravel required for one entire yard of concrete of different proportions:*

Proportions.	Cement.	Sand.	Gravel or broken stone.
	Bbls.	Bbls.	Bbls.
1 x 2 x 4,	1.57	3.14	6.28
1 x 2½ x 5,	1.29	3.23	6.45
1 x 3 x 6,	1.10	3.30	6.60
1 x 4 x 8,	1.85	3.40	6.80

Four bags of Portland cement are considered a barrel or 3.8 cu. ft.; one bag contains .95 cu. ft. A cubic foot weighs about 100 lbs.

*For Concrete Construction about the Home and on the Farm.

The mixing should be done by two men on a concrete board which is a smooth water-tight platform about 9 x 10 ft. It is made of one-inch board surfaced on one side, using five two-inch by four-inch by nine-foot cleats to hold them together. "The object of the surfaced boards to make the shoveling easy. The boards are so laid as to enable the shoveling to be done with and not against the cracks." "It is a good precaution against losing cement grout to nail a two-inch by two-inch or two-inch by four-inch around the outer edge of the board."

"Measure the sand and spread in a layer of even depth. Place the cement on top and turn with shovel at least three times or until the two are thoroughly mixed, as shown by uniform color. Stone thoroughly wet should be thrown on top of the whole and turned at least three times. water being slowly added on the second turning, the quantity varying according to the nature of the work. In general sufficient water should be added to give a mushy mixture just too soft to bear the weight of a man when in place. Pails are most convenient for measuring the water, and enough pailfuls should be provided in advance for wetting an entire batch. Do not use a hose. A wheelbarrow of known capacity or a box without a bottom and with the sides extended to form handles may be used for measuring the sand and gravel.

"The finishing coat should be scored to afford a foothold for the animals. Joints should be made not more than twelve feet apart to avoid cracks. It is generally thought best to lay the floor in alternate sections rather than consecutively or continuously."

THE OPEN SHED

For many years the question of shelter for fattening animals has received the attention of investigators and writers interested in the economic phases of feeding beef cattle. In the work conducted by Dr. H. P. Armsby, where the energy values of feeding stuffs were determined it was found that the expenditures of energy in the ordinary process of mastication, digestion and assimilation resulted in the generation of heat in greater quantities than was needed to keep the body up to normal temperature when an accurate record of the energy of feeds and the products produced was kept.

Based upon these results, a number of tests were made in Pennsylvania, Missouri, Utah and Kansas to determine the influence of shelter upon the rate and cost of gains made by fattening steers.

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*Bulletin, No. 20, Assn. An. Portland Cement Manufactures,

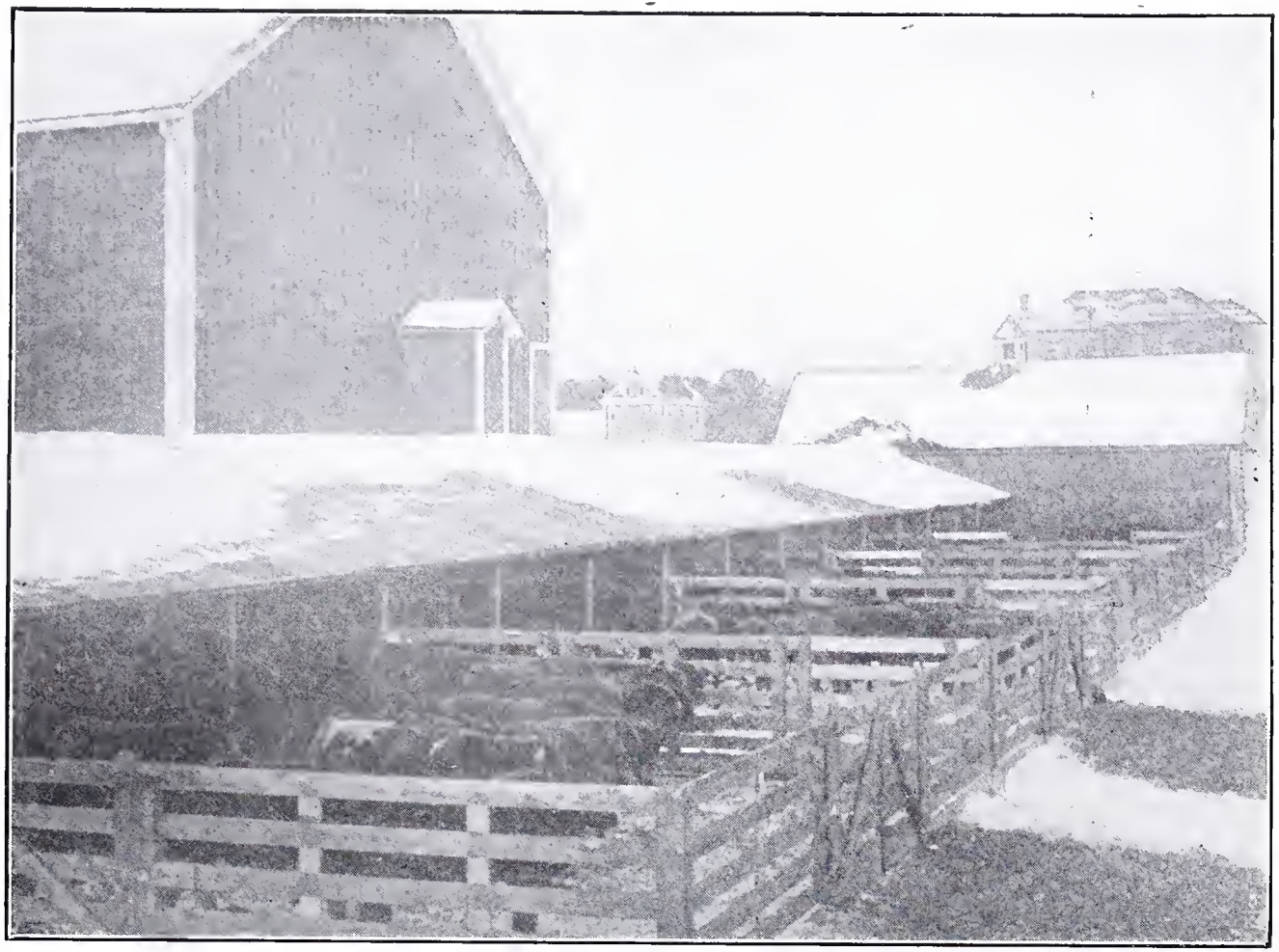


Fig. 31. CATTLE SHEDS AT PENNSYLVANIA STATE COLLEGE.

The yards are too small, but in other respects this shed is satisfactory.
Barns and silo in rear of shed, feed house at end. Feed is delivered to managers by carrier.

A summary of results of five years of feeding cattle in the basement of an ordinary Pennsylvania bank barn with better light and ventilation than is usually found as compared with an open shed boarded up closely on three sides, the open side facing the south, is given herewith. These results were secured in connection with the feeding of dry feed exclusively:

FIVE YEARS' SHELTER EXPERIMENT*

	In Open Shed.	In Barn.
Hay fed per pound of gain,	2.96 lbs.	3.04 lbs.
Stover fed per pound of gain,	3.08 "	3.12 "
Grain fed per pound of gain,	9.51 "	9.49 "
Daily gain per steer,	1.95 "	1.93 "

It will be noticed that the steers fed in barn required more feed to produce a pound of gain and that the rate of gain was less than for those fed in the shed. It should be stated in this connection that the results were not always in favor of the shed. During two winters when bedding was not available in sufficient quantites to provide a dry bed at all times in the open shed, the steers in the barn gave better results.

While the foregoing results indicated that cattle fed on dry feeds did not require warm feeding quarters, there was still a question as to the advisability of feeding such succulent feeds as corn silage in open sheds. In order to determine this point, a test was made during the winter of 1910-11 covering this point at The Pennsylvania State College, from which the following data are taken:

SHELTER EXPERIMENT WITH SILAGE

	In Shed.	In Barn.
Hay consumed per pound of gain,	.79 lbs.	.78 lbs.
Stover consumed per pound of gain,	.92 "	1.09 "
Corn silage consumed per pound of gain,	7.18 "	7.93 "
Grain feed consumed per pound of gain,	6.98 "	7.71 "
Daily gain per steer,	2.36 "	2.13 "
Cost of cattle per cwt. at close of experiment,	$6.46	$6.63
Selling value per cwt.,	7.75	7.60
Profit per steer,	14.67	10.69

*See p.

*Penna. Experiment Station.

From this presentation it will be seen that the open shed is decidedly superior to the barn for fattening cattle which are fed largely on silage, as its use resulted in cheaper and more rapid gains and an increase in selling price of 15c. per cwt.

The accompanying illustration (see Fig. 31) shows the open shed and the basement of barn in which these experiments were conducted. Based upon the results given, a shed was constructed especially for the purpose of handling experimental cattle, an illustration of which also appears.

This new shed is 150 feet long and 22 feet deep. Running lengthwise and adjacent to the open side of the shed is a lot 25 feet deep. The shed is boarded up on the east, west and north sides while the south side remains open. It is divided into five lots of 30 feet each in length, which accommodates from 12 to 15 cattle and the hogs used in connection with them. Under the shed proper 14 feet is used for cattle, $2\frac{1}{2}$ feet for mangers and $5\frac{1}{2}$ feet for feeding alley. The feeding alley and bottom of manger are made of concrete. Posts are set 5 feet apart in front of manger to which a 2 x 6 is fastened to prevent steers from getting into their feed. The floor of the shed is clay, the lot is covered with a cement floor, and a retaining wall 8 inches high surrounds it in order to prevent loss of manure. There is a 6 inch fall from level of shed floor to the rear end of lot in order that any water accumulating in lots may not back up into the shed.

This shed has been in use two years, during which time it has proved to be exceptionally well adapted to the purpose. The only objection is that it requires large quantities of bedding to keep the shed floor dry enough to make the cattle comfortable. It could be improved by raising the bottom of the manger six inches above the level of the floor of the shed in order that manure might accumulate during such times as it was inconvenient to haul to the field, without making it difficult for cattle to eat their feed. The points of advantage that are secured from the use of such a shed are the ease and convenience in feeding, the ability to feed cattle without going into the lot, rapid and economical gains, thrift and health of steers and the practicability of feeding steers and hogs together. It is well to state in this connection that there has not been a single case of sickness in the feeding of over 100 head of cattle in this shed for the past two years. During the winter 1911-12 beef breeding cows are

maintained on a ration consisting of one pound of cottonseed meal and sixty pound of corn silage without hay or other grain or roughage, and while temperatures have fallen lower than at any other time in the last quarter of a century, these cows have not apparently suffered in the least from the method of housing. They have gained in weight, thrift and appearance on this very succulent feed and are producing good, strong, vigorous calves. It would seem from this work that such a shed is just as useful for maintaining breeding cattle and growing young stock as for fattening steers.

CHAPTER XV

COMPUTING RATIONS

All ordinary feeding stuffs are composed of water and dry matter. The amount of water present is quite variable, but is fairly constant for any one kind kept under the usual barn or warehouse conditions. It varies some with the weather, but after the crop is once thoroughly cured this variation is not great unless unduly exposed. Since the feed is primarily given to the animals not for the water it contains but for the dry matter alone in most cases it is desirable to know approximately the amount of moisture present.

The dry matter is made up of a large number of compounds which for convenience are divided into groups according to general composition and the function they perform in nourishing the animal so far as known. The following diagram shows the different groups of compounds that go to make up all feeding stuffs:

COMPOSITION OF FEEDING STUFFS

A. Water.
B. Dry Matter.
    1. Mineral Matter (Ash).
    2. Organic Matter.
        a. Protein
        b. Carbohydrates
            (a) Crude fiber
            (b) Nitrogen-Free-Extract
        c. Fat (Ether Extract).

In making up a ration only the organic matter is usually considered. It is thought that any ration which is made up of both roughage and concentrates will probably contain enough ash, while one composed of grain only may be deficient in this constituent. Until more is known about ash requirements we shall ignore it largely in making our rations except for swine and poultry. *Protein* is a general name given to certain compounds which contain nitrogen. The

chemist determines the per cent. present by multiplying the amount of nitrogen found by 6.25 since protein on the average contains about 16 per cent. nitrogen. This is sometimes called *crude protein,* since the protein in some feeds contain more than 16 per cent. nitrogen and since there are some nirogenous compounds in feeds which are not true protein.

The *carbohydrates* do not contain nitrogen but are composed of carbon united with oxygen and hydrogen, the latter two in the proportion to form water hence the name carbohydrates. There are two general classes of carbohydrates, one form of which cellulose or woody fiber is the type and known in a fodder analysis as *crude fiber* is not soluble in water and so far as we know is not acted upon directly by any of the digestive ferments; the other class consists chiefly of starches and sugars and is found in what the chemist reports as *nitrogen-free extract.*

The *fat* of a feeding stuff is determined as *ether extract;* that is everything that can be dissolved out by repeated washing with ether is counted as fat. As a matter of fact there are in some feeds a small quantity of a few other compounds as chlorophyll and wax dissolved with the fat, hence some prefer to call it *crude fat* or *ether extract.*

The following table taken from Farmers' Bulletin 346, will serve to show the average composition of some of our common cattle feeds:

AVERAGE COMPOSITION OF FEEDING STUFFS

(From Farmers' Bulletin No. 22, revised edition.)

Feeding Stuff.	Water.	Ash.	Crude protein.	Carbohydrates.		Fat (ether extract).
				Crude fiber.	Nitrogen-free extract.	
Green fodder and silage:	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Alfalfa,	71.8	2.7	4.8	7.4	12.3	1.0
Clover—crimson,	80.9	1.7	3.1	5.2	8.4	.7
Clover—red,	70.8	2.1	4.4	8.1	13.5	1.1
Corn fodder,	79.3	1.2	1.8	5.0	12.2	.5
Corn silage,	74.4	1.5	2.2	5.8	15.0	1.1
Hungarian grass,	71.1	1.7	3.1	9.2	14.2	.7
Rape,	85.7	2.0	2.4	2.2	7.1	.7
Rye fodder,	76.6	1.8	2.6	11.6	6.8	.6
Timothy,	61.6	2.1	3.1	11.8	20.2	1.2
Hay and dry coarse fodders:						
Alfalfa hay,	8.4	7.4	14.3	25.0	42.7	2.2
Clover hay—red,	15.3	6.2	12.3	24.8	38.1	3.3
Corn forage, field cured,	42.2	2.7	4.5	14.3	34.7	1.6
Corn stover, field cured,	40.5	3.4	3.8	10.7	31.5	1.1
Cowpea hay,	10.7	7.5	16.6	20.1	42.2	2.9
Hungarian hay,	7.7	6.0	7.5	27.7	49.0	2.1
Oat hay,	16.0	6.1	7.4	27.2	40.6	2.7
Soy bean hay,	11.3	7.2	15.4	22.3	28.6	5.2
Timothy hay,	13.2	4.4	5.9	29.0	45.0	2.5
Straws:						
Oat straw,	9.2	5.1	4.0	37.0	42.4	2.3
Rye straw,	7.1	3.2	3.0	38.0	46.6	1.2
Wheat straw,	9.6	4.2	3.4	38.1	43.4	1.3
Roots and tubers:						
Carrots,	88.6	1.0	1.1	1.3	7.6	.4
Mangel-wurzels,	91.2	1.0	1.4	.8	5.4	.2
Potatoes,	78.9	1.0	1.5	.8	5.4	.2
Rutabagas,	88.6	1.2	1.2	1.3	7.5	.2
Turnips,	90.6	.8	1.3	1.2	5.9	.2
Grains:						
Barley,	10.9	2.4	12.4	2.7	69.8	1.8
Corn,	10.9	1.5	10.5	2.1	69.6	5.4
Corn-and-cob meal,	15.1	1.5	8.5	6.6	64.8	3.5
Oats,	11.0	3.0	11.8	9.5	59.7	5.0
Pea meal,	10.5	2.6	20.2	14.4	51.1	1.2
Rye,	11.6	1.9	10.6	1.7	72.5	1.7
Wheat,	10.5	1.8	11.9	1.8	71.9	2.1
By-products:						
Brewers' grains—dried,	8.0	3.4	24.1	13.0	44.8	6.7
Brewers' grains—wet,	75.7	1.0	5.4	3.8	12.5	1.6
Buckwheat middlings,	11.8	4.8	28.0	6.3	41.9	7.2
Cotton-seed meal,	8.2	7.2	42.3	5.6	23.6	13.1
Distillers' grains—dried—						
Principally corn,	7.0	2.0	29.2	11.0	39.4	11.4
Principally rye,	6.8	2.1	17.3	12.3	54.0	7.5
Gluten feed—dry,	8.1	1.3	23.2	6.4	54.7	6.3
Gluten meal—Buffalo,	8.2	.9	24.5	6.1	47.8	12.5
Gluten meal—Chicago,						
Linseed meal—old process,	9.2	5.7	32.9	8.9	35.4	7.9
Linseed meal—new process,	9.9	5.6	35.9	8.8	36.8	3.0
Malt sprouts,	10.2	5.7	23.2	10.7	48.5	1.7
Rye bran,	11.8	3.5	14.7	3.3	63.9	2.8
Sugar-beet pulp—fresh,	89.9	.4	1.0	2.2	6.3	.2
Sugar-beet pulp—dried,	6.4	3.3	10.8	19.8	58.4	1.3
Wheat bran,	11.9	5.8	15.4	9.0	53.9	4.0
Wheat middlings,	11.8	4.8	28.0	6.3	41.9	7.2

*Total N x 6.25.

This table is not used in computing rations, but is used in calculating the next table.

DIGESTIBLE NUTRIENTS

It is well known that no feed which an animal eats is completely digested. By weighing and analyzing the feed given and the excrement voided, the per cent. of the different constitutents of the various feeds which are digested has been determined. The number indicating the per cent. of any constitutent digested is known as the digestion coefficient of that constituent. By applying the digestion coefficient to the table of composition we get the amount of digestible nutrients. Since the animal derives benefit only from the digested portion this is the table used in computing rations. As will be shown later even the amount of digestible nutrients is not a strictly accurate measure of the value of a feed, but as it was until recent years the most accurate index known, and is fairly accurate for comparing different feeds within the same class, is convenient and is the method in common use it is given here. It is the method given in nearly all text books on feeding.

It has been found that a pound of digestble carbohydrates and a pound of digestible protein will if burned produce about equal amounts of energy but that a pound of fat will produce about two and a fourth times as much. It is customary therefore in determining total digestible matter to multiply the fat by two and one-fourth.

DRY MATTER AND DIGESTIBLE NUTRIMENT IN SOME COMMON FEEDS.

(Adapted from Henry's Feeds and Feeding, Revised Edition.)

Feeding Stuff.	Dry matter.	Digestible Nutrients.		
		Crude protein.	Carbohydrates.	Fat.
Green fodder and silage:				
Alfalfa,	28.9	3.0	12.1	0.4
Clover—crimson,	19.1	2.4	9.1	0.4
Clover—red,	29.2	2.9	14.9	0.7
Corn fodder,	20.7	1.0	11.9	0.4
Corn silage,	26.4	1.4	14.3	6.7
Hungarian grass,	28.9	2.0	15.9	0.4
Rape,	14.3	2.0	8.2	0.2
Rye fodder,	23.4	2.1	14.1	0.4
Timothy,	38.4	1.5	19.9	0.6
Hay and dry coarse fodders:				
Alfalfa hay,	93.6	11.7	40.9	1.0
Clover hay—red,	84.7	7.1	37.8	1.8
Corn forage, field cured,	57.8	2.5	34.6	1.2
Corn stover, field cured,	59.5	1.4	31.2	0.7
Cowpea hay,	89.5	6.8	39.3	1.3
Hungarian hay,	86.0	5.0	46.9	1.7
Oat hay,	86.0	4.7	36.7	1.7
Soy bean hay,	88.2	10.6	40.9	1.2
Timothy hay,	86.8	2.8	42.4	1.3
Straws:				
Oat straw,	90.8	1.3	39.5	0.8
Rye straw,	92.2	0.7	39.6	0.4
Wheat straw,	90.4	0.8	35.7	0.4
Roots and tubers:				
Carrots,	11.4	0.8	7.7	1.3
Mangel-wurzels,	9.1	1.0	5.5	0.2
Potatoes,	20.9	1.1	15.7	0.1
Rutabagas,	11.4	1.0	8.1	0.2
Turnips,	9.9	0.9	6.4	0.1
Grains:				
Barley,	89.2	8.4	65.3	1.6
Corn,	89.4	7.8	66.8	4.3
Corn-and-cob meal,	84.9	4.4	60.0	2.9
Oats,	89.6	10.7	50.3	3.8
Pea meal,	89.5	16.8	51.7	0.7
Rye,	91.3	9.5	69.4	1.2
Wheat,	89.5	8.8	6.75	1.5
By-products:				
Brewers grains—dried,	91.3	20.0	32.2	6.0
Brewers' grains—wet,	23.0	4.9	7.6	1.7
Buckwheat middlings,	87.2	22.7	37.5	6.1
Cotton-seed meal,	93.0	37.6	21.4	9.6
Distillers' grains—dried—				
Principally corn,	93.0	21.2	42.4	10.8
Principally rye,	93.2	8.7	.....	6.3
Gluten feed—dry,	90.8	21.3	52.8	2.9
Gluten meal,	9.5	29.7	42.5	6.1
Linseed meal—old process,	90.2	30.2	32.0	6.9
Linseed meal—new process,	91.0	31.5	35.7	2.4
Malt sprouts,	90.5	20.3	46.0	1.4
Rye bran,	88.4	11.2	46.8	1.8
Sugar-beet pulp—fresh,	10.2	0.5	7.7	.....
Sugar-beet pulp—dried,	91.6	4.1	64.9	.....
Wheat bran,	88.1	11.9	42.0	2.5
Wheat middlings,	88.8	13.0	45.7	4.5

By simply multiplying the figures found in this table by the number of pounds of any feed taken, we get the number of pounds of dry matter and of the different digestible nutrients it contains. For example, twelve pounds of alfalfa hay will contain 12 times 93.6 per

cent. or 11.2 lbs. of dry matter, 12 times 11.7 per cent. or 1.4 lbs. of digestible protein, 12 times 40.9 per cent. or 9 lbs. of digestible carbohydrates, and 12 times 1.0 per cent. or 0.12 lbs. of digestible fat. If we multiply the fat by $2\frac{1}{4}$ to reduce it to the carbohydrate equivalent, we have 5.2 lbs. of digestible carbohydrates and fat. In like manner we find that 12 pounds of oat straw contains 10.9 lbs. of dry matter, 0.16 lbs. digestible protein and 5.0 lbs. of digestible carbohydrates and fat.

NUTRITIVE RATIO

Since the animal is a machine, there is constant wear and tear of its parts. One of the functions of food is to furnish material for the renewal of worn out tissue. Another function is to build up the body, that is to cause an increase in size; a third is to keep the animal warm, and a fourth is to perform work. Food supplied over and above that required for these four purposes may be stored in the body in the form of fat. The vital active tissues and organs of the animal are composed largely of protein and must therefore have protein to renew them as they wear out. The growing animals must have protein to build tissue. The energy can be had more economically from carbohydrates and fats. The ratio between digestible protein and digestible carbohydrates and fats is known as the *"Nutritive Ratio."* For the sake of simplicity and uniformity the first terms of the ratio is always stated as 1. Thus if we had a feed containing 2 pounds of digestible protein to 12 pounds of digestible carbohydrates and fat, the nutritive ration would not be stated as 2:12 but as 1:16. The nutritive ration thus found by proportion; for the first term take the digestible protein; for the second term the digestible carbohydrates plus $2\frac{1}{4}$ times the digestible ether extract or fat, and for the third term 1. Thus merely dividing the second term by the first gives the fourth; e. g. 2 : 12 :: 1 : 6.

A nutritive ration is said to be narrow when it has a relatively large amount of digestible protein as compared with the digestible carbohydrates and fat, and wide when it has a relatively small amount of digestible protein. The terms wide and narrow when applied to nutritive ratios are relative and not absolute. Thus the ratio of red clover, 1 : 5, is wide whe compared with that of gluten feed, 1 : 3.3, but narrow when compared with that of corn meal, 1 : 12 : 9.

BALANCED RATIONS

A *ration* is the amount of feed an animal receives in a day. A ration is said to be well balanced when the digestible protein and the digestible non-nitrogenous nutrients are in such proportion that each will be used up without any waste of either. Balancing the

ration or computing a balanced ration consists in combining the feeding stuffs in such proportion that the animal will get just what it needs of each class of nutrients. It is evident that a young animal since it is building tissue must have a larger proportion of protein than one of the same class that is not growing. In like manner the animal that is being fattened should have a larger proportion of carbohydrates and fat than one of the same size and class that is not being fattened. Milk production being a form of growth requires a relatively larger proportion of nitrogenous nutrients.

A feeding standard is a statement of the amount of dry matter, and amount of digestible protein and digestible carbohydrates and fat supposed to be required by an animal daily. Tables of feeding standards have been computed and are to be found in most books on feeding. The so-called Wolff-Lehmann standards are the ones that have been most widely published. The following figures from a table in Bulletin of Information No. 1, of the Pennsylvania Experiment Station, now out of print, gives their standards for beef cattle.

GROWING CATTLE

Age—Months.	Average weight.	Dry matter.	Digestible.			
			Protein.	Carbohydrates and fats.	Total.	Nutritive ratio.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
2— 3,	150	3.3	0.6	2.8	3.4	1:4.6
3— 6,	300	7.0	1.0	4.9	5.9	1:4.9
6—12,	500	12.0	1.3	7.5	8.8	1:6.0
12—18,	700	16.8	1.4	9.7	11.1	1:7.0
18—24,	850	20.4	1.4	11.1	12.5	1:8.0

These figures are per head daily.

FATTENING CATTLE PER 1000 LBS. LIVE WEIGHT.

	Dry matter.	Digestible.			
		Protein.	Carbohydrates and fats.	Total.	Nutritive ratio.
Preliminary period,	27.0	2.5	16.1	18.6	1:6.4
Main,	26.0	3.0	16.4	19.4	1:5.5
Finishing,	25.0	2.7	16.2	18.9	1:6.0

These standards especially for fattening cattle are richer in digegestible nitrogenous nutrients and therefore have a narrower nutritive ratio than American feeders and experimenters have generally found profitable. A feeding standard is at best merely suggestive of what should be fed and is in no sense a perfect guide.

If it is desired to make a ration from corn silage, alfalfa hay and ear corn, we may take as trialcation 20 lbs. of silage, 10 lbs. of hay and 15 lbs. of corn which gives us the following:

	Dry matter.	Digestible Nutrients.		
		Protein.	Carbohydrates.	Fat.
	Lbs.			
Corn silage, 20 lbs.,	5.28	28	2.84	.14
Alfalfa hay, 10 lbs.,	9.36	1.17	4.09	.10
Ear corn, 15 lbs.,	12.73	.66	9.00	.44
	27.37	2.11	15.93	.68

Multiplying the fat by $2\frac{1}{4}$ and adding it to the carbohydrates gives 27.31 lbs. of dry matter, 2.11 lbs. of digestible protein and 17.46 lbs. of digestible carbohydrates and fat. This is higher in dry matter and carbohydrates and fat and lower in protein than the standard calls for at any time, but still may be the most economical. In order to bring this close to the standard it will be necessary to replace part of the feeds having a wide nutritive ratio with something having a narrower nutritive ratio. We may let the silage and hay remain the same and instead of feeding 15 lbs. of ear corn feed 13 lbs. of ear corn and one pound of cottonseed meal. This will give a ration containing 2.61 lbs. of dry matter, 2.40 lbs. of protein and 16.56 lbs. of carbohydrates and fats with a nutritive ratio of 1 : 6.9. If this is still considered too wide we may take 12 lbs. of ear corn and 2 lbs. f cottonseed meal which will give 26.69 lbs. of dry matter, 2.73 lbs. of digestive protein and 16.31 lbs. of digestible carbohydrates and fat having a nutritive ratio of 1 : 6.0.

If instead of alfalfa hay there is fed 20 lbs. of silage, 10 lbs. of red clover hay, 12 lbs. of ear corn and 2 lbs. of cottonseed meal the ration will contain 25.80 lbs. of dry matter, 2.27 lbs. of digestible protein, and 16.18 lbs. of digestible carbohydrats and fat with a nutritive ratio of 1 : 7.1.

If silage and hay are not available and it is necessary to use corn stover alone for roughage, more cottonseed meal or other nitrogenous concentrate will be needed. For trial we may take 15 lbs. of corn stover, 10 lbs. of shelled corn, 2 lbs. of cottonseed meal and 2 lbs. of gluten feed. Tabulating the composition we get the following:

	Dry matter.	Digestible Nutrients.		
		Protein.	Carbohydrates.	Fat.
Corn stover, 15 lbs.,	8.93	.21	4.68	.11
Shelled corn, 10 lbs.,	8.94	.78	6.68	.43
Cotton-seed meal, 2 lbs.,	1.86	.75	.43	.19
Gluten feed, 2 lbs.,	1.82	.43	1.05	.06
	21.55	2.17	12.84	.79

Multiplying the fat by $2\frac{1}{4}$ and adding it to the carbohydrates we have 21.50 lbs. of dry matter, 2.17 lbs. of digestible protein and 14.60 lbs. of digestible carbohydrates and fat with a nutritive ratio of 1 : 7.7. This is too low all around, so we increase the amount of corn stover to 20 lbs. and for the sake of variety substitute oil meal for gluten feed. This will give 24.50 lbs. of dry matter, 2.41 lbs. of digestible protein and 16.03 lbs. of digestible carbohydrates and fat; nutritive ratio 1 : 6.6.

ENERGY VALUE

It has been found that not all of the energy of the fod digested by an animal is available either for maintenance or production When an animal is fed a certain ration a part of the energy of the nutrients digested is used up in handling the feed, so that the net available energy is less than the energy of the digested portion. Dr. Armsby by means of the respiration calorimeter has found that a greater per cent. of the energy of the digested portion of grains and concentrates is available for production than of roughage. He has prepared the following table of energy values to be used in computing rations instead of the table of digestive nutrients.

DRY MATTER, DIGESTIBLE PROTEIN, AND ENERGY VALUES PER 100 POUNDS

(From Farmers' Bulletin 346.)

Feeding Stuff.	Total dry matter.	Digestible protein.	Energy value.
	Pounds.	Pounds.	Therms.
Green fodder and silage:			
Alfalfa,	28.2	2.50	12.45
Clover—crimson,	19.1	2.19	11.30
Clover—red,	29.2	2.21	16.17
Corn fodder—green,	20.7	.41	12.44
Corn silage,	25.6	1.21	16.56
Hungarian grass,	28.9	1.33	14.76
Rape,	14.3	2.16	11.43
Rye,	23.4	1.44	11.63
Timothy,	38.4	1.04	19.08
Hay and dry coarse fodders:			
Alfalfa hay,	91.6	6.93	34.41
Clover hay—red,	84.7	5.41	34.74
Corn forage, field cured,	57.8	2.13	30.53
Corn stover,	59.5	1.80	26.53
Cowpea hay,	89.3	8.57	42.76
Hungarian hay,	92.3	3.00	44.03
Oat hay,	84.0	2.59	36.97
Soy bean hay,	88.7	7.68	38.65
Timothy hay,	86.8	2.05	33.56
Straws:			
Oat straw,	90.8	1.09	21.21
Rye straw,	92.9	.63	20.87
Wheat straw,	90.4	.37	16.56
Roots and tubers:			
Carrots,	11.4	.37	7.82
Mangel-wurzels,	9.1	.14	4.62
Potatoes,	21.1	.45	18.05
Rutabagas,	11.4	.88	8.09
Turnips,	9.4	.22	5.74
Grains:			
Barley,	89.1	8.27	80.75
Corn,	89.1	6.79	88.84
Corn-and-cob meal,	84.9	4.53	72.05
Oats,	89.0	8.36	66.27
Pea meal,	89.5	16.77	71.75
Rye,	88.4	8.12	81.72
Wheat,	89.5	8 90	82.63
By-products:			
Brewers' grains—dried,	92.0	19.04	60.01
Brewers' grains—wet,	24.3	3.81	14.82
Buckwheat middlings,	88.2	22.84	75.92
Cotton-seed meal,	91.8	35.15	84.20
Distillers' grains—dried—			
Principally corn,	93.0	21.93	79.23
Principally rye,	93.2	10.38	60.93
Gluten feed—dry,	91.6	19.95	79.32
Gluten feed—Buffalo,	91.8	21.56	88.80
Gluten meal—Chicago,	90.5	33.09	78.49
Linseed meal—old process,	90.8	27.54	78.92
Linseed meal—new process,	90.1	29.26	74.67
Malt sprouts,	89.8	12.36	46.33
Rye bran,	88.2	11.35	56.65
Sugar-beet pulp—fresh,	10.1	.63	7.77
Sugar-beet, pulp—dried,	93.6	6.80	60.10
Wheat bran,	88.1	10.21	48.23
Wheat middlings,	84.0	12.79	77.65

Based upon the investigations of Dr. Armsby and some German experiments, the following feeding standard for maintenance and for growing cattle in terms of digestible protein and energy values is recommended.

These tables are also taken from Farmers Bulletin 346:

MAINTENANCE REQUIREMENTS OF CATTLE PER DAY AND HEAD

Live Weight.	Cattle.	
	Digestible Protein.	Energy Value.
Pounds.	Pounds.	Therms.
150	0.15	1.70
250	.20	2.40
500	.30	3.80
750	.40	4.95
1,000	.50	6.00
1,250	.60	7.00
1,500	.65	7.90

ESTIMATED REQUIREMENTS* PER DAY AND HEAD FOR GROWING CATTLE

Age.	Live Weight.	Digestible Protein.	Energy Value.
Months.	Pounds.	Pounds.	Therms.
3	275	1.10	5.0
6	425	1.30	6.0
12	650	1.65	7.0
18	850	1.70	7.5
24	1,000	1.75	8.0
30	1,100	1.65	8.0

*Including the maintenance requirement.

REQUIREMENTS FOR FATTENING

The foregoing data refer to what might be called normal growth, in which the animals are kept in a good thrifty condition, but do not become fat. If any considerable fattening is desirable, somewhat heavier rations must be given in proportion to the amount of gain made, because the increased gain in fattening animals consists to a very large extent of fat, and therefore means the storing up by the animal of more reserve energy. For fairly mature fattening animals—such, for example, as the 2 to 3-year-old steers which are commonly fattened in the corn belt—probably 3.5 therms per pound of gain in live weight is a fair allowance, although more appears to be often used in practice. As yet no corresponding data are available for the fattening of growing animals, as, for example, in the production of the co-called "baby-beef." It is not probable, however, that any larger amount of protein is required in such fattening than in feeding simply for normal growth, so that the additional food given for fattening may, from this point of view, consist largely of non nitrogenous material, i. e., carbohydrates and fats. It is to be noted, however, that an excess of these materials in the ration tends to cause less perfect digestion, and also that a moderate proportion of the more nitrogenous concentrates seems to aid in securing the consumption of heavy rations. Kellner recommends that at least 1 pound of digestible protein be supplied in the ratio for each 8 to 10 pounds of carbohydrates and fat."—(Farmers' Bulletin 346.)

RATION FOR FATTENING STEERS

According to this standard an animal weighing 1000 pounds should have in its feed 50 lbs. of digestible protein and 6.00 therms of net energy for maintenance. In addition it should have about 3.5 therms per pound gain in live weight. If it is assumed that it will gain 2 pounds per day, the energy required will be $3.5 \times 2 + 6.0 = 13$ therms. If mixed timothy and clover hay, about half and half, is to be fed with shelled corn in the proportion two pounds of hay to three pounds of corn the amount required for 13 therms of energy is found as follows:

100	pounds of clover hay furnishes	34.74 therms
100	" " timothy furnishes	33.56 "
300	" " corn furnishes	265.52 "
500	" " feed furnishes	333.82 "
1	pound of feed furnishes	.668 "

It will therefore require as many pounds of feed to furnish 13 therms as .668 is contained times in 13, which is 19.5 pounds. Since two-fifths if this hay and three-fifths grain we may make it in even numbers, eight pounds of hay and 12 pounds of shelled corn.

The above ration satisfies the requirements so far as energy is concerned but should be tabulated to see if the amount of digestible protein is right. From the table on page — we compute the following:

	Dry Matter.	Digestible Protein.	Energy Value.
	Pounds.	Pounds.	Therms.
Clover hay, 4 lbs.,	3.39	.216	1.39
Timothy hay, 4 lbs.,	3.47	.082	1.34
Shelled corn, 12 lbs.,	10.69	.815	10.66
	17.55	1.113	13.39

The amount of digestible protein is seen to be considerably less than that recommended for growing cattle of this weight. Since this animal should grow as well as fatten for best results the amount of digestible protein should be increased to at least 1.75 lbs. In order to do this it will be necessary to either increase the ration until the amount of digestible protein equals this amount or replace a part of it with some feed rich in this constituent. It is evident that such an increase would result in a waste of energy and feed, therefore the other plan will be followed. It is easier and generally cheaper to get protein in concentrates than in roughage.

An examination of the table shows that dried brewers' grains, buckwheat middlings, cottonseed meal, distillers grains (principally corn), gluten meal, and linseed meal are all comparatively rich in this nutrient. The one selected will be largely a matter or price and convenience, although palatability and general effect are to be considered. It may be decided to replace a part of the corn with distillers' dried grains, principally corn. The ration is seen to be about .64 pounds of digestible protein short; it will therefore require about 3 pounds of distillers' grains to make up the deficiency. But in removing part of the corn the deficiency is made greater, therefore, 4 pounds of the distillers' grains is taken.

	Dry Matter.	Digestible Protein.	Energy Value.
	Pounds.	Pounds.	Therms.
Clover hay, 4 lbs.,	3.39	.216	1.39
Timothy hay, 4 lbs.,	3.47	.082	1.34
Shelled corn, 8 lbs.,	7.13	.543	7.11
Distillers' grains, 4 lbs.,	2.72	.877	3.17
	17.71	1.718	13.01

This comes close enough to the estimated requirements. As it is customary to limit the grain ration only, and feed the hay according

to the appetite of the animals, and as the relative amount of grain and hay will vary in different stages of the fattening period, closer figuring is useless.

If cottonseed meal instead of distillers' grains had been chosen to furnish the protein, two pounds would have been sufficient and the ration would have been: Hay 8 pounds, shelled corn 10 pounds, cottonseed meal 2 pounds.

Ration for Calf: If a calf six months old is to be wintered and kept growing on clover hay and a grain mixture of half shelled corn and half oats feeding twice as much hay as grain the amount of feed required is computed as follows:

400 pounds of clover hay furnishes	138.96	therms
100 " " corn furnishes	88.84	"
100 " " oats furnishes	66.27	"
600 pounds of feed furnishes	294.07	"
1 pound of feed furnishes	.49	"

[According to the standard the calf will need 6 therms, which will be furnished in a little more than 12 pounds of feed. This will consist of 8 pounds of hay and 2 pounds of corn and oats.]

	Dry Matter.	Digestible Protein.	Energy Value.
	Pounds.	Pounds.	Therms.
Clover hay, 81 lbs., ...	6.78	.43	2.78
Corn, 2 lbs., ...	1.78	.14	1.78
Oats, 2 lbs., ...	1.78	.17	1.33
	10.34	.74	5.89

Since this ration contains more protein than is required for maintenance the calf will be able to grow some, but since it contains less than that estimated to be required for animals of this size for growth, it cannot grow as much as it naturally would if more protein were furnished. This protein can be had by increasing the amount of the ration or by replacing the corn by a more nitrogenous concentrate. If the hay is increased to ten pounds and one pound of old process linseed meal added the ration figures out as follows:

	Dry Matter.	Digestible Protein.	Energy Value.
	Pounds.	Pounds.	Therms.
Clover hay, 10 lbs., ...	8.47	.54	3.47
Corn, 2 lbs., ...	1.78	.14	1.78
Oats, 2 lbs., ...	1.78	.17	1.33
Linseed meal, 1 lb., ...	.91	.28	.79
	12.94	1.12	8.37

This ration does not yet have enough protein but has an excess of energy value. The latter will probably only result in keeping the animal fat which is not objectional if it is to be pushed for baby beef. The ration may also be too laxative in which case cottonseed meal may be used instead of linseed meal, or may be used in addition to the above. A grain ration composed of corn 2 lbs., oats 2 lbs. cottonseed meal 1 lb., and linseed meal 1 lb., with clover hay ad libitum would be about right. Wheat bran may be substituted for oats and part of the oil meal, if cheaper.

CHAPTER XVI

CATTLE CROPS

GRASS

Grass is the greatest of all cattle crops, grows under more diversified conditions than any other and must ever be considered as a necessary adjunct to the production of beef. As a general rule, less attention is paid to the production of grass either as a pasture or meadow than to any other farm crop. In the State of Pennsylvania 3,988,105 acres out of a total of 18,586,832 acres in farm land is devoted to grass. In the future this acreage will be largely increased by the addition of waste land now producing nothing but brush and weeds, by the drainage of low, wet and swampy areas and by the seeding to permanent pastures much of the hill and mountain side land on which other crops are proving to be unprofitable. The State of Pennsylvania, because of its climate, soil and topography, is essentially adapted to the production of grass. Little attention has been paid to the selection of varieties adapted to special soil conditions, to heavy grazing by cattle or to furnishing pastures that will furnish an abundance of feed throughout the season.

PASTURES

The pastures of Pennsylvania are usually found in those areas which are too wet or too steep to plow and those which are considered valueless for other purposes. A rational system of fertilization of pastures is yet to be discovered and applied. It is generally recognized, however, that continuous grazing from year to year, without the use of supplementary feeds or the application of plant food in the form of fertilizers, is certain to result in the decreased return from the land. The growing and fattening animal removes large quantities of nitrogen, phosphorus and lime and a limited amount of potash from the soil which must either be replaced or the yield decrease.

In order to secure the maximum yield from pastures, a thick heavy sod formed by a large variety of grasses and legumes should be obtained. Kentucky blue grass (or green grass as it is called in many sections), timothy, red top, meadow fescue, brome grass, white, medium, red and alsike clover should form the basis of pastures on the heavier soils of the State. On lighter soils Canadian blue grass may possibly be substituted for the more tender and less hardy Kentucky variety. To secure such a sod is the work of five to ten years under favorable conditions, but when once secured it will last indefinitely when properly handled. Newly seeded areas are more easily injured by tramping, close grazing and pasturing either very late or very early in the season.

After a good permanent pasture has been secured, it should profit with but little attention. In order to do so, it is necessary that it be allowed to go into the winter with sufficient growth to catch the snow and serve as a protection from washing by heavy rains of the early spring. When there is an abundance of grass stock may be allowed to run over pastures with impunity until the breaking up of winter, when they should be removed until the ground has become settled and the new growth has secured a good start. Grass in the early spring has but little substance and should not be used for grazing purposes unless supplemented with hay, silage or other roughage. During the months of July and August there is usually a drought, either of short or long duration, which should be anticipated either by the growth of soiling crops to be used or the use of silage. It frequently happens that during this period beef cattle, because of the shortage of feed, lose all that they have gained during the flush pasture period of spring and early summer.

On some of the best grazing lands in the United States it is the practice of owners to stock pastures only with the number of animals that can be carried through a period of one month of drought. In most sections, however, the practice is to stock pastures to their full capacity during the best of the grazing period, which not only results in a loss in weight of animal during the dry season, but on account of the deficiency of feed, they are allowed to graze off every vestige of grass, pull up much of it by the roots, thus not only injuring the pasture temporarily, but exposing the ground to the hot rays of the sun and baking it to such an extent that many plants perish. The feeding of supplementary crops at this season not only insures a gain on the part of the animals but is equally as efficient in adding to the fertility of the soil. An execellent method of maintaining pastures is to practice summer feeding of grain on grass or to feed roughage, such as corn fodder or hay, on pastures in the winter. A discussion of these practices occurs in other chapters of this bulletin.

CORN

Corn is second in importance only to grass as an essential crop on a farm devoted to the production of beef. It is palatable and nutritious, yields a large amount of digestible dry matter per acre, can be grown in every county of the State and is the chief source of fat, heat and energy-forming nutrients in the rations of all farm animals. Recent results secured at the Wisconsin Station show clearly that animals fed entirely on corn and its products have a larger amount of vitality, remain in better condition and breed more regularly than similar animals kept exclusively on wheat products. It should always be kept in view, however, that the exclusive use of corn, not supplemented with feeds rich in protein and mineral matter for young, growing animals or for the breeding herd will result in indigestion, loss of appetite, slow rate of gain and permanent reduction in size. On the other hand, when properly supplemented with nitrogenous concentrates and hay from legumes, a maximum degree of thrift, rate of gain and a full maintenance of size is attained.

ALFALFA

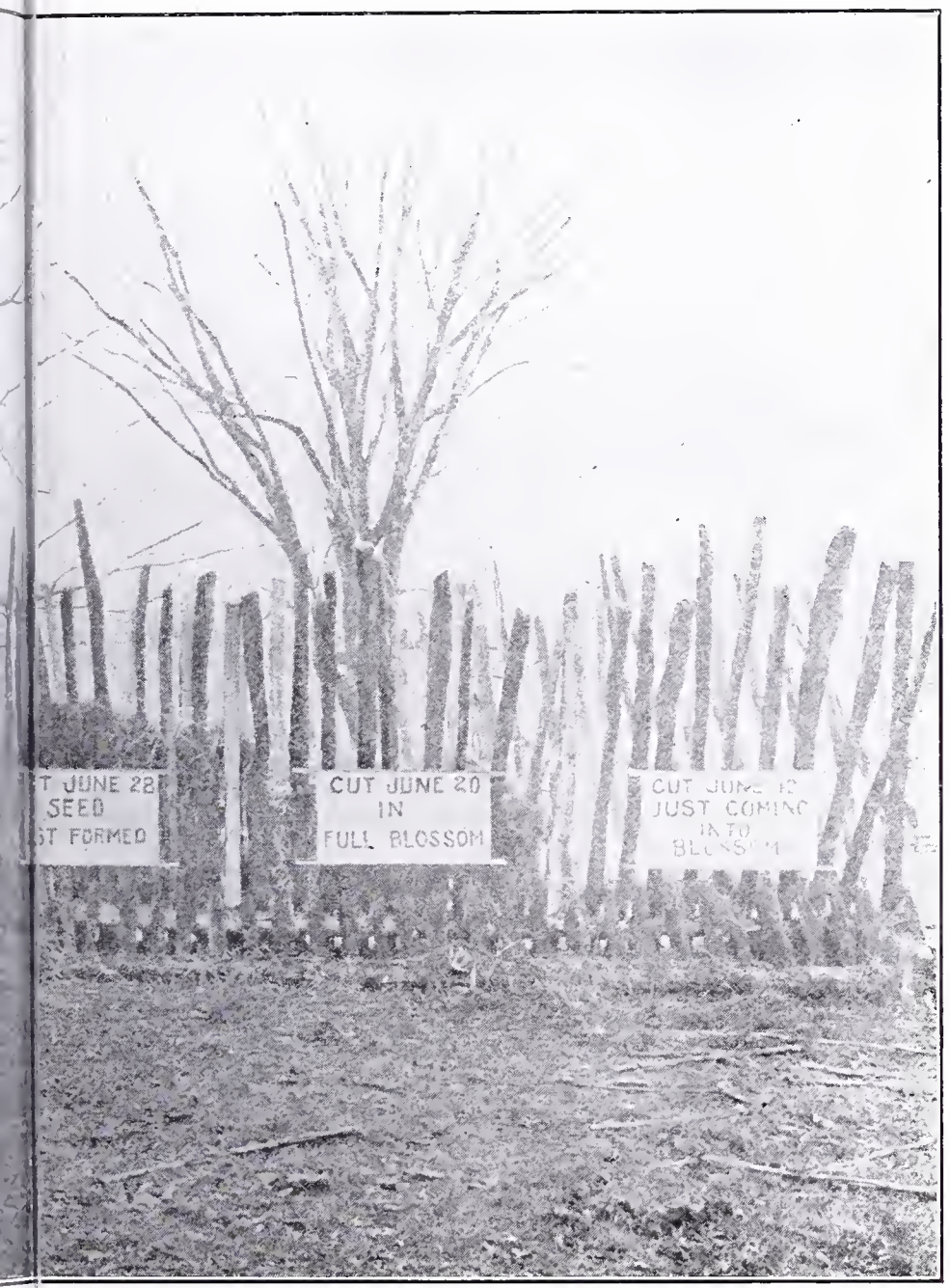
Alfalfa furnishes the best roughage for beef cattle of all ages. It is palatable, nutritious, rich in protein and yields a large amount of dry matter per acre. While it is being grown successfully in every county of the State, there are many failures registered in an attempt to grow it. It is not the function of this bulletin to take up the question of crop production, but it is well to state that there are four essentials for success in alfalfa culture—drainage, a sweet soil, a well-prepared seed bed free from weed seeds and the presence of proper bacteria in the soil. With any of these neglected, its growth is very uncertain. The disadvantages in alfalfa production, after a good stand has been secured, is that the first cutting comes at the busiest season of the year and that it is frequently impossible to cut it properly on account of frequent rains. For best results in its use as a feed, it should be harvested at the proper stage, cured without rain and handled in such manner that the leaves will be retained. The second, third and fourth crops are to be preferred to the first for the feeding of cattle. Alfalfa fields should not be pastured by cattle in this climate on account of danger of bloat.

CLOVER

All of the different clovers are relished by livestock and should be used to supplement non-leguminous crops. In order to secure maximum returns from their use as a feed, they should be harvested before the stems have become too woody, cured without rain and handled so as to preserve the leaves. While cattle will eat clover that has shattered its leaves or been injured by rain during the cur-

Fig. 32. A LESSON IN CUTTI

The Missouri Experiment Station turned cattle into racks filled with timoth hay cated in the racks. If saving hay is the object, cut it late; if it is to be palatab to c



ING HAY FOR CATTLE.

ay cut at different periods as shown in the photograph. The result is indi-
o cattle, cut it early.

ing process, its feeding value is greatly reduced. There is little difference in the feeding value of either alsike or common red clover, both of which are superior to the mammoth variety. The clovers rank next to alfalfa as hay crops for cattle.

OTHER LEGUMES

Other legumes, such as cowpeas, soy beans and vetch, are not largely grown in the State. Cowpeas yield a large amount of forage when soil and season are favorable to their growth. This is the most difficult of all forage crops to cure, but if successfully done, the hay is equal to alfalfa in feeding value. Their area in this State will always be limited by climatic conditions. Soy beans are a grain rather than a forage crop, but they make fine hay when grown for that purpose, equal to clover or alfalfa. Their value in feeding hogs is such that they can hardly be fed to cattle. Vetch is a crop which has been grown in very limited areas in the State. Hay made from this crop is especially palatable and nutritious, ranking with alfalfa in feeding value. Canadian field peas are frequently grown with oats to be used as a soiling crop. If allowed to mature and harvested in good condition this mixture ranks in value between alfalfa and clover as a feed.

TIMOTHY

Timothy should never be grown as a crop for feeding beef cattle where a short rotation is practiced. The general custom is to sow this seed in connection with clover in order that there may not be a complete failure in the hay crop. Some of the soils of the State which may not produce clover successfully give large yields of timothy. Under such conditions, if possible, the timothy should be exchanged for clover, which is one and one-half times as valuable for cattle-feeding purposes. Where this is impossible or impracticable, the timothy should be harvested just as it comes into blossom, as the early-cut hay is much more readily consumed than that which has been allowed to mature. Where it is necessary to feed timothy hay to beef cattle the grain ration should contain a liberal amount of laxative nitrogenous concentrates in order to insure good health and satisfactory gains, or it should be fed with silage.—(See Fig. 32.)

OTHER GRASSES

Millet is frequently grown as a catch crop and sometimes to replace a crop which has failed in the regular course of rotation. It has the advantage of producing a large amount of forage in a comparatively short period of time. It may be considered slightly more valuable than timothy as a feed and requires the same sort of supplements to produce maximum results. In order that it may be used without harm to beef cattle, it should be cut before the seed has ma-

tured, and fed in such manner that stock will consume not only the heads but the entire stem of the plant. If possible, it should not be used for more than one-half of the roughage ration, being supplemented by hay from leguminous plants. Sorghum or sugar cane is useful as a forage crop, especially in supplementing pastures during the summer. Only the first cutting should be used for this purpose and it should be fed after it has approached maturity. The use of second growth or immature plants of the first crop is apt to cause death from poisoning. If necessary to use or harvest it before maturity, the plants should be thoroughly cured before feeding. As a general rule, corn will produce more feed per acre than any of the sorghum or canes in Pennsylvania, hence they should be planted only when the corn crop has failed. Sorghum is a very difficult crop to cure, owing to the large amount of water retained in the stalk at the time of harvesting. Frequently indigestion occurs from feeding it during the early part of the winter, because of the moisture in the stalks being frozen.

Red Top Orchard Grass, Brome Grass and the Fescues are generally used only as pasture grasses. The first two produce hay of very inferior quality, especially when allowed to mature. The last two produce hay superior to timothy when properly harvested and cured. Blue grass produces hay of excellent quality, but the yield is so light as to eliminate this grass from meadows and confine it to pastures.

OATS

Oats is one of the most widely grown crops in the State. While oats are palatable and nutritious, their market value is usually so great in proportion to the nutrients contained that they are unprofitable as a cattle crop. Oats can usually be replaced with highly nitrogenous concentrates to advantage. When grown for hay they are cut at an earlier stage of growth than when harvested for grain, and if properly handled, make a feed superior to timothy but inferior to clover. There are times when oats seem to be indispensable: for young calves learning to eat grain, for replacing corn in the ration just before shipment of cattle and in cases where cattle are scouring, due either to the character of their rations or to indigestion. Oats are frequently sown with Canadian field peas as a soiling crop. This mixture makes hay of superior quality if cut at proper stage of maturity.

ROOT CROPS

Root crops are valuable, in that they produce a large amount of digestible dry matter per acre, furnish succulence and are used by the animal with comparatively little expense of energy in mastication, digestion and assimilation. Because of the large amount of manual labor required in their production and care necessary in stor-

ing them, they are more expensive than the majority of cattle crops. In the State of Pennsylvania, they should be grown in those sections where the elevation is too great for the best development of corn, while they are quite bulky, they should always be considered as concentrates rather than roughage because of their low percentage of crude fiber.

CORN SILAGE

While the silo first proved its usefulness on dairy farms, the progressive feeder of beef cattle has learned that the use of silage, when properly supplemented with other feeds, results in cheaper and more rapid gains, a higher finish and a greater degree of health and thrift on the part of his cattle. Other advantages in the use of silage are that a greater amount of dry matter may be grown and utilized from an acre of corn stored in this manner than in any other way. It is harvested at a time when labor on the farm is not in greatest demand; it leaves the fields in excellent condition for preparation of seed bed for succeeding crops; a larger amount of feed can be stored in a silo than in any other manner. The necessity of handling corn stalks in manure is avoided; it is a cheap, succulent form of roughage that replaces grass in the winter rations, acting as an appetizer, a conditioner and a food for cattle of all ages and degrees of condition. And the manure from it is in best condition to put on meadow lands, which is the best place for manure. Next to grass, it is the most useful feed for beef cattle.

CHAPTER XVII

SLAUGHTERING CATTLE ON THE FARM*

Practically all the beef consumed on the farms of Pennsylvania in the winter season is slaughtered and dressed there. Much of that sold in the villages and small towns is also prepared on the farm. It is an advantage then for the farmer to know how to handle the animal easily and expeditiously to produce a neat and attractive carcass, which will furnish meat of the best quality.

SELECTING ANIMALS

Health: This obviously should always be the first consideration in selecting an animal that is to be used for food. While there may be no direct harmful results from the use of meat from animals not in good health it is best to take no chances. Besides the danger of having the disease transmitted in the food, the meat from an animal that is diseased will be hard to keep. As the tissues are not in normal condition, fermentation is much more apt to take place soon after the animal has been dressed and left to cool. This is especially true of animals that are suffering from some disease with which there is a fever. There is little danger of diseased meat being put out on the market for food, if it has been prepared in a packing house that does an interstate business. Laws have been passed which provide for United States government inspection in all these places. This inspection is very rigid, and every animal that is found diseased so as to be unfit for food is condemned. There is also a law in this State which provides for the inspection of local slaughterhouses by the Livestock Sanitary Board, who look after the sanitation of local shops, and the destruction of diseased meat. It is the duty of every citizen to do what he can by co-operating with the State and United States governments in demanding the destruction of distased carcasses.

*This chapter has been compiled for the most part from a lesson by Prof. W. H. Tomhave.

Condition and Quality. The condition of the animal that is to be slaughtered is of much importance and meat from a well rounded animal in good prime condition is much better than that from one in poor condition. Meat from such a carcass has more juices, and the flavor is much better. The meat is not so hard and dry. The amount of fat that is mixed with the lean makes the meat more palatable and gives it more bulk. It also permits it to ripen better and does not dry up so when cooked. A man may want lean meat but he wants it to come from a fat animal. The amount of meat in proportion to bone is greater, which also increases the value of the carcass. An animal that is losing in flesh should never be slaughtered, as meat from such an animal will be dry and tough due to the withdrawal of the juices and the shrinking of the muscles. It usually has a very dark appearance and is hard to cure.

Some of the indications of good quality in live animals are firm and dense bone free from roughness and coarseness. Soft, mellow hide covered with a thick, smooth and soft coat of hair. The body thickly fleshed, evenly covered with fat and free from patches and wrinkles.

Age. The age at which to slaughter animals will vary under different conditions. While cattle may be slaughtered at the age of eighteen to twenty-four months, the meat from such animals lacks the flavor that is secured from cattle twenty-four to thirty-six months old. Old cows make good carcasses at any time if properly fitted. Calves should never be killed under four weeks, and produce the best carcasses when from six to ten weeks old if properly fed.

Preparation: There are a number of things that are essential and must be observed in preparing an animal for slaughtering, in order to secure the best quality of meat. The animals should always be kept off feed for at least twenty-four hours. Unless this is done, the paunch will be very much distended and filled with food which will decompose rapidly after slaughter and when dressing is slow the gases generate and often flavor the meat. The blood vessels will be filled with the nutrients of the food and will not drain well giving the carcass a reddish and unattractive appearance. The animal should have all the water he will drink as that helps drain the system. He should not be excited or over-heated, as by so doing the temperature of the body is raised one or two degrees, which makes it more difficult to cool the carcass and also results in stringy or gluey meat that will sour very easily. In no case should an animal be bruised or pounded in any way. When this is done the places where the bruises are made can nearly be seen on the outside of the carcass by a gathering of blood on the surface that cannot be removed and results in a poor appearance. It is always well to train animals to lead before taking them to be slaughtered as that oftentimes will mean the difference between a poor and a good carcass and the animal will be much easier to handle.

Tools: It is not necessary to have a full butcher's outfit to do the work properly. It is well, however, to be provided with a few tools that can be secured at a reasonable cost, such as a six-inch skinning knife, twelve-inch steel, twenty-six-inch saw, pritch, six-inch sticking knife, steak knife, and an apparatus of some kind for raising the carcass.

The tools should always be in good shape to be able to do the best work. The knives sharp and everything ready when the work is to begin. In grinding a knife that is to be used for skinning the best way is to grind it on a level with a slant of about 45 degrees on the left side of the blade. Since nearly all the skinning is done with the right hand there is little danger of cutting the hide when the knife is ground in this way. Never grind the knife too thin, as this usually results in a poor edge and a dull knife when the bone is touched. The sticking knife should be ground on both the front and the back of the tip, with about the same amount on each side. Steak knives and cleavers should only ground on the cutting edge.

Place to do the Work: It is not necessary to have a building in which to do the killing, although it is more convenient if it can be provided. Where the work is done out in the open a high place should always be selected. When there is plenty of drainage so that the blood and water can drain away from around the carcass, a bed of nice clean straw can be provided and will add much to the cleanliness of the work.

Stunning: The first thing necessary is some means of properly securing the animal. This is done by putting a halter on the head, by making a rope halter or putting a rope around the neck. The rope should then be tied shortly to a tree, a pole, a strong ring on the side or in the floor of a building, or to anything substantial to hold the animal till stunned. Where the slaughtering is done in a slaughterhouse the cattle are usually driven in a narrow chute or killing pen, where they are stunned without tying. The stunning is done my means of a heavy hammer, or killing bolt, or by shooting. The place to stun an animal is in the center of the forehead. To locate this place draw imaginary lines from the base of the horns to the eye on the opposite side; where these lines intersect is the proper place to stun. Sometimes an awl or narrow bladed knife is used to sever the spinal cord in the atlas joint just back of the poll.

Sticking: This is a very important part of the operation and the object is to draw the blood from the carcass as quickly as possible, aided by such facilities as may be had, such as having the animal drop with the head lower than the hind parts, or by hanging the carcass up by the hind legs. The best place to stick is as near the

heart as possible. In sticking use a six inch skinning or sticking knife, the skinning knife is in this case preferred. When the animal is dropped on the side put your one foot in front of the front legs and the other just in under the head. Draw the head back as far as possible so as to draw the skin on the throat tight. Make a long cut from the throat to the brisket. Cut through the flesh to the windpipe, and with the blade set immediately in front of the brisket with the sharp edge toward the head, cut a little more than right angles to the neck, parallel to the front line of the shoulder on both sides of the windpipe. By cutting in this way the arteries will be struck which divide immediately upon leaving the heart. Be careful not to cut too far back, for if this is done the blood will flow into the chest cavity and fill it which will badly discolor the ribs. This discoloration is hard to remove when the carcass is cold. Another method of sticking is to remove the skin on either side of the throat back to the ears, and then cut the jugular vein immediately on either side of the pharynx. This, however, is a poorer method of sticking as the blood is not removed so quickly as by sticking near the heart.

Kosher killing is another method of sticking animals used for the Jewish trade. The orthodox Jew of to-day abides by the same rules that were laid down in the Mosaic laws for his ancestors. The killing is done by a "Shekter" who, instead of stunning an animal, cuts the throat just back of the jaw bone severing all the veins and arteries.

Skinning: Begin skinning at the head by skinning out the face and sides to and over the poll and back along on each side of the throat as far as possible. First skin out the side that is up and then by the assistance of another person or by inserting an iron rod or steel in the nostrils the head can be drawn up so as to skin out the under side. When all the hide on the head has been skinned off, remove the head by cutting across the atlas joint which can be detected by the "Adam's apple" or rise in the windpipe. Cut down on each side of the joint cutting all the muscles and connective tissue and the spinal cord. This joint can easily be cut with a knife without the use of an ax or saw. As soon as the head is removed the tongue should be taken out; this is done by cutting on each side immediately within the jaw bones loosening at the top and cutting so as to include all the tongue fat. Put the tongue at once in warm water and scrape off all the dirt or particles that adhere to it. These can easily be removed by scraping with a knife against the projections on the surface. Then hang the tongue up or put it away in some place to cool.

The carcass should next be put on its back in order to continue further skinning. Brace the sides by means of a block or pritch. The pritch is a piece of wood about three feet long with steel points on each end. This is inserted through the hide just back of the

elbow and put into the ground or floor to brace the carcass. Begin skinning the legs by cutting across the enlargement of the knee joint on the lower side; at this place the straight joint is located. Cut in deep enough to straighten the leg, then make a cut through the center of the leg between the dewclaws from the knee to the hoof cutting down on each side far enough to remove the dewclaws which are usually left on the hide. Then cut off the leg at the joint that has been opened and skin out the back side by using the leg as a handle. Do not skin out any more of the fore arm while the carcass is on the ground, as blood and dirt is liable to stain the tissue and cannot be removed. Next remove the hind legs. Begin by cutting across the tendons between the dewclaws and hocks which is done to straighten the leg. Draw the leg forward or between one's legs, then with a knife laid flat over the hock cut back to the mid line, to a point about three inches back of the cod. Care should be taken in making this cut not to cut into the lean meat on the back of the round. Skin down the sides of the hocks and cut a hole through the hock between the tendons for the beef tree. This should be done at this time as it makes it more convenient to work. Next skin down the shank to the hoofs cutting on each side and remove the dewclaws, after which remove the shank just at the enlargement of the hock joint cutting from the top side, or where the knife will go in the deepest, cutting out a straight joint. A great deal of difficulty is often experienced in breaking this joint. Be sure that all muscles and connective tissues on the outside are cut. This is all the skinning that is done on the hind legs at the present. Next make a long cut through the mid line from the brisket to the tail. Begin skinning on the left side at the neck and skin down over the brisket and the sides as far as possible, but leave the hide on the shoulders. In skinning on the sides the operator should always be sure to hold the knife flat against the hide and have the hide drawn tight as in this way there is much less danger of cutting either the hide or carcass. Skin back the hind legs and rump just far enough down to have the hide on the fore part of the thigh and over the lower part of the rump removed. Continue in this way on both sides as far as possible.

Removing Intestines: Before opening up the carcass get a hot wet cloth and remove any particles of blood or dirt that may be on the outside of the carcass. The internal organs should then be loosened and partly removed. This is done at this time, as it makes the carcass much easier to handle and can be done more conveniently than after the carcass is drawn up. Make a cut through the mid line from the brisket to the pelvic bone. Cut in deep enough to expose the paunch just at the tip of the breastbone. Then take the knife between the thumb and forefinger and insert the hand into the abdominal cavity; use the full hand as a guide and cut back to the

pelvic region. Rip out the caul fat which is usually exposed on the paunch when the opening is first made, then throw the intestines out on the left side so as to make room for splitting the pelvic bone. The breastbone will now have to be split either with a saw or ax, a saw preferably, as it makes a smoother cut. At the same time loosen the gullet and the windpipe, as it is much more difficult to loosen these after the carcass has been drawn up. Next split the pelvic bones either with a saw or ax. The beginner will probably have some difficulty in cutting in the center, but by reaching in the inside of the abdominal cavity the sharp edge of the pelvic bone can be easily felt. This with the white connective tissue on the outside can be used as a guide to keep in the center.

Before raising the carcass a beef tree or doubletree must be secured to put through the hocks to spread and hold the sides apart. If a doubletree or beam is used, it is well to have a spreader made of a thin piece of wood to keep the sides apart.

Raising Carcass: This can be done by means of a windlass, block and tackle, or other contrivances such as a hay fork rope and pulleys, tripod or any convenient way of raising the carcass from the ground. Raise the carcass so that the rump is about four feet from the ground or just high enough that further skinning around the rump and round can be done. This part is usually known as rumping. Skin out the tail by cutting down the mid line, and remove the tail at about the second joint from the body. Loosen the skin around the cut end and the tail can be pulled out of the hide. Then continue skinning over the rump and down over the back as far as possible. While the carcass is in this position long strokes can be taken and it is the best position for skinning over the rump and loin. The operator should be careful not to score or cut the hide or carcass. In working around the tail head, great care must be taken not to get into the lean meat. Care should also be taken not to remove the thin covering over the round when the hide is being removed, because if this is done the muscles will be exposed which gives the round a very bad appearance and causes quicker fermentation. The hide on the round can be easily removed by pulling it down. Before raising the carcass higher it is well to continue removing the internal organs. Loosen the rectum by cutting around it at the surface, follow down removing the bladder at the same time. Continue to remove all the organs in the abdominal cavity including the liver, being careful to leave all the kidney fat and bed fat in the carcass. The bed fat is the fat that lines the pelvic region. Before taking out the liver remove the gall bladder, as in that case there will be no danger of spilling the gall or bile over the liver or any part of the carcass. Before removing the organs of the thoracic cavity raise the carcass high enough to clear the ground. Then remove these organs by cutting the diaphragm, which separates the abdominal

and thoracic cavities, cutting just on the outside of the skirting of the muscle which attaches to the wall of the body. Then remove the heart, lungs and windpipe cutting close to the backbone in order to remove the large blood vessel which lies just below the vertebrae, and being careful not to remove the fat which is found on the inside of this cavity.

Siding and Backing: As soon as all the internal organs have been removed begin taking off the hide over the sides and back. With the knife against the hide take long, deep cuts over the sides from the hip bones to the shoulder being careful at all times to keep the skin very tight so as to have a smooth surface on the outside of the carcass, skin clear down over the shoulders to the backbone leaving the hide attached at the hip in order to keep it from falling down over the knife. Continue in this way from both sides until the mid line has been reached. As soon as this is done take the knife and loosen the hide where it is left attached to the hips and it can easily be removed and will leave a very smooth covering over the loin, ribs and shoulder. After this take a hot wet cloth and remove all the particles of blood on the outside of the carcass.

Splitting: This is usually done by means of a cleaver or saw. A saw probably is a more desirable instrument, as it requires a great deal of practice and experience to do a neat job with a cleaver. The left kidney lies over the right and covers the inside of the backbone on the loin. The kidneys should be parted so as to expose the backbone from the inside. Then begin to split at the rump and try to cut as near the midline as possible, saw from the outside, and always let the weight of the saw do the work. Never bear down on the saw as by so doing it is very difficult to keep exactly in the center of the backbone. In sawing it is always well to hold the saw at an upward slant so as to strike right in the center of the spinous processes which are usually less than a quarter of an inch in thickness and project toward the outside. Be careful not to cut to the side and expose the tenderloin. The great difficulty experienced in splitting carcasses is the danger of getting to either side of the mid line. Continue splitting until near the shoulder where the hide has not been removed. Then raise the carcass a little higher from the ground and remove the hide from the shoulders and neck. In skinning over the shoulder be careful not to remove the red patches of meat in the pit of the elbow as by doing this it gives the carcass a hollow appearance through the shoulder. In skinning the fore arms and neck the operator should be careful not to cut the meat or to leave too much fat on the hide. As soon as the hide has been removed continue spliting through the shoulder and neck. In this region of the shoulder the spinous processes are very long and care must be taken to split them exactly in the center as cutting to either side will expose a great deal of lean meat and does not give equal weight to both sides.

Finishing: With a hack saw or other sharp instrument cut through the spinous processes about midway between the vertebrae and tip ends just deep enough to break them. Then with a cleaver or blunt instrument of some kind strike the ends which will make the muscles draw together and gives the shoulder a much more rounded and thicker appearance. Then remove all the scraggy portions around the neck and on the carcass, at the same time removing the spinal cord which is exposed on each side of the vertabrae. Open up the blood vessels which go into the shoulder and manipulate the front legs to remove all blood that may be gathered there. When this is done all particles of blood anywhere on the outside should be removed. If plenty of hot water can be had, it is well to scrub the outside of the carcass well, as it gives it a much whiter color. The carcass should then be put away to cool but care must be taken not to have it cool too rapidly, as immediate freezing on the outside would form a crust on the surface and might cause the meat to sour on the inside, due to the fact that there is no chance for the escape of the animal heat.

Saving the Hide: After the hide has been removed it should be spread out flat on the ground or floor, and, if warm weather, sprinkled with salt and left in that position to be thoroughly cooled. It is well to split the ears after the hide is thoroughly cooled and then roll it up in a bundle so that it can be tied and sent to market. Do this by lapping the skin of the head and legs over onto the body of the hide. Then fold in from each side and beginning at the front end, roll into a tight bundle and tie with heavy tarred twine or light rope.

CHAPTER XVIII

PENNSYLVANIA'S CATTLE STATIONS

CATTLE FEEDING IN EASTERN PENNSYLVANIA*

Lancaster county has the enviable reputation of being the leading agricultural county in the United States. There are several causes which enter into the bringing about of such an agricultural status. One of the main causes, if not the leading cause, is the large number of cattle that are annually fed on the farms of the county. Each year there are about 4,000 carloads, or 120,000 head, of cattle sold at the Lancaster stockyards. About 40 per cent. of the above number are bought to be fed on Lancaster county farms. The remainder are sold to the farmers of the adjoining counties of Chester, York, Berks, Lebanon and Cumberland, or are butcher cattle sold for slaughter.

The average margin between prices of feeders and fat cattle during the last 25 years has been 1¼ to 1½ cents per pound. In one or two years the advance was ¼ to ½ cent per pound. In a few cases the price received in the spring was less than the price paid in the fall. The average total selling price for Lancaster county cattle for a year is nearly $1,000,000 above the fall buying price. Part of this large sum is of course paid out for bran, etc., but at least three-fourths of the amount represents the value of the home-grown crops of corn and grass sold on the hoof.

The feeding period varies from 5 to 8 months with an average of 6½ months. Most of the feeders are bought in September, October and November and sold in April, May and June. One-fourth to one-fifth of the cattle bought by the farmers are fed lightly during the winter and turned to grass in the spring and sold as grass fat cattle in July, August and September.

*By Enos H. Hess of Lancaster County, Pa.

METHODS AT FEEDING

Many of the farmers prefer to buy the cattle in time to be able to turn them on grass for a few weeks before stabling them. While on pasture many feed a light ration of bran, corn nubbins, etc. The ration during the winter consists mostly of corn-and-cob meal and bran, equal parts by measure, and hay and corn stover. Some feed heavier than one-half by measure of bran, while some feed as light as one-fourth bran. A few feeders add linseed or cottonseed meal or gluten meal, etc., but only in small quantities.

The cattle are nearly all fed loose in the stables of the warm bank barns of the county. Formerly they were chained in separate stalls. In many instances the cattle are supplied with water in the stable and only let out in the yard when the stable is to be cleaned. Where water is not supplied in the stable the cattle are let out, mostly before the noon meal, for watering. The grain ration is usually fed twice per day and the roughage three times.

In recent years the writer has fed his cattle in an open shed or covered barnyard in which running water is supplied by means of water power, and has had very satisfactory results. The labor entailed in this method is scarcely half of that of the stall chain method. My father, for instance, would let out his steers in lots of three and have all the water to pump. He would clean the stables three times a week with the wheelbarrow. With the open shed the cattle need to be bedded three or four times per week and the manure hauled direct to the field in the early spring.

GAIN IN WEIGHT

The average daily gain for the stall-fed period of $6\frac{1}{2}$ months is about $1\frac{3}{4}$ pounds. The gain per day varies from 1 to 3 pounds, depending on the quality of the cattle, kind and quantity of feed and skill of the feeder. The steers that I had in the open shed gained 413 pounds each in $6\frac{1}{2}$ months, or 2.12 pounds per day. A bull fed the same length of time gained 650 pounds, or $3\frac{1}{3}$ pounds per day. The best record in feeding that my father ever made was 683 pounds gain on a steer in 7 months. Although 30 years ago, I can well remember the rather rough-framed, thin in flesh red-and-white spotted animal he was.

The principal point in making good gains in feeding cattle is to feed at regular times, not even allowing the much-loved Sabbath morning extra nap to interfere with the feeding schedule, and feed to the full limit up to maintaining a keen appetite for the next meal. The latter point requires skill and watchfulness to determine, and

when a steer does get "off feed" the best remedy is a pound of Epsom salts and a cutting down or even out of the grain ration for a few days. Cattle may be eating well in cold, bright weather, but if fed the same quantity in mild, sultry weather, such as we often have here during the winter season, they will go off feed and the feeder, if not skilled, will scarcely know "what's the matter."

QUALITY IN CATTLE

The quality in cattle is a factor in profitable feeding that is frequently not given the attention that it deserves. The imparting of the knowledge of what goes to make up quality is not an easy task. Judges differ some in their opinions, the same as in what constitutes a good cow. I am not averse to a long rib and a big stomach in a cow, and from a feeder's standpoint a good development in these parts is not objectionable in a steer. The right kind although a trifle "paunchy" in the fall will largely outgrow or hide that butcher defect by spring.

The feeders of this section have come to be partial to cattle from the different cattle-raising sections. Buffalo or Canadian-raised cattle have the preference, next in popularity are the Western or Chicago cattle, while last in the list come the Southern or Virginia cattle. Frank B. McClain, one of Lancaster's largest dealers, claims that for same quality and weight in fall and similar feed and attention the Northern and Western cattle will gain 100 pounds more in a given period than Virginia or Southern cattle. In late years St. Paul cattle have been gaining favor with our feeders. They are light in weight as a rule upon arrival here—400 to 1,000 pounds, but have been making satisfactory gains.

QUALITY IN THE CARCASS

The farmers of this section sell very little roughage off the farm, and in some instances considerable corn is bought besides the bran and other concentrates. My opinion is, that it would pay the cattle feeder to buy sparingly of corn as a supplement to his own crop. It would pay better, I believe, to buy the rich nitrogenous concentrates as linseed or cottonseed meal. It is a well-demonstrated fact that protein in the feed makes the very much desired marbled beef and pork. Nearly two-thirds of my grain ration for the past two years has been bran, cottonseed and linseed meal. Our butcher is always anxious to know when we have cattle to sell. The bull that gained 100 pounds per month, he claimed, cut the best he had in a hundred. The extra cost per ton of cottonseed or linseed meal is more than made up in the increased fertilizing value of the excrement of the cattle. With the open leachy farmyard this may be largely wasted, but with a covered yard or direct from stable to field method of handling the manure we believe that it will pay.

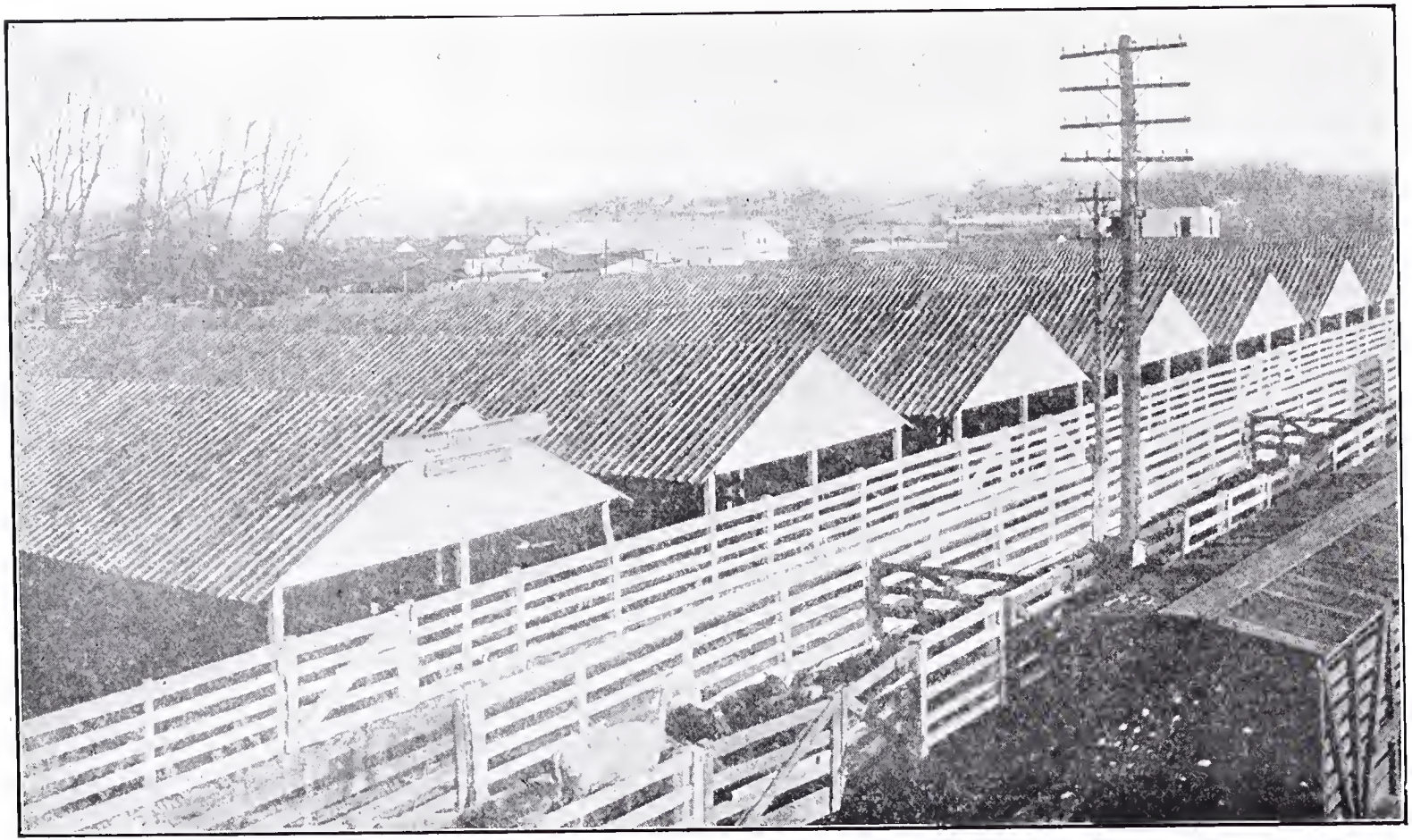


Fig. 33. THE STOCKYARDS AT LANCASTER, PA.,

Where more feeding cattle are handled than at any other point in the East. The cattle go into the feed-lots in the fall and to the fat stock market the next spring.

GRAZING IN SOUTHWESTERN PENNSYLVANIA

The cattle industry in southwestern Pennsylvania is based on bluegrass and timothy hay. Greene county now finishes more steers than any other county west of the mountains, Washington county having become a dairy section to a large extent. Bluegrass grows naturally here and the old sods make fine pastures. Timothy meadows are cut for years without reseeding, until they "run out" or are captured by the bluegrass. These two cattle feeds are provided with a minimum of labor. Corn is fed in limited quantities to the steers during the winter and also to the fattening steers on grass, but it is not largely produced or extensively fed. In recent years the silo has been brought into use to winter the steers and more silos will be used for this purpose right along. The corn area will be and should be limited in this section because the cost of producing it is high and because the waste of fertility is great with any hoed crop on hilly land. Alfalfa is being grown in a small way. If alfalfa production proves to be a success in this section the cattle industry should prosper as never before. Alfalfa and bluegrass make an ideal combination for cheap beef production, epecially when the grass is of such quality as grows on these hills.

The usual practice of farmers in this section is to buy feeders in the fall, winter them and send them to market off grass the following summer and fall. The steers are usually purchased in West Virginia, though some have come from Western markets or from Canada. These steers weigh 800 to 1,000 pounds when bought, and are fairly well bred. They are run on grass as long as grazing is possible in the fall, after which they are fed hay and fodder until grass comes again. Sometimes a bluegrass pasture is saved for winter use, and if the winter is open the steers will do very well with comparatively little hay. Some feeders give their steers a little grain during the winter, others feed hay only, and some market-topping steers have been produced without having eaten a bite of grain. A two-year-old Shorthorn raised and finished in this way, sold at $8.25 in Pittsburgh in 1911, the top of the market, but he had pure breeding as well as good hay and grass behind him.

In the spring the cattle are turned out to grass and either fed a little grain or none at all as the condition of the grass and the cattle demands. Usually they do very well without grain on a good bluegrass pasture, but grain makes a quicker finish. In normal seasons, when the grass becomes dry in midsummer, cattle ripen very well on it. If it is wet and watery they do not fatten so well, though they may make as good gains, and in such a season they should be hardened with a little corn in addition to their grass.

If a steer gains 300 pounds during the year or less that he has been in the hands of the feeder he is doing very well, but some do better than this. If the steer weighs 1,000 pounds in the fall and

costs $5 per cwt., gains 300 pounds and sells at $6 per cwt., he has paid his owner $28 for the hay and grass eaten, and that produced with a minimum of expense. The cheapness of production of the feed used, the probability of getting more than $1 per cwt. advance on the steer, the fact that the labor cost is very light, form the foundation of this industry in southwestern Pennsylvania. There is no water problem, as never-failing springs abound which supply it practically without cost. The profits in the business are not large, but the labor problem is not difficult, the steers eat roughage which could not be utilized otherwise, and they convert the grass into a marketable product with a minimum of cost.

Some steers are raised in this section and their treatment is much the same as that of the fattening steers. These calves are from the cows used in the farm dairy, usually grades of the beef breeds. They are weaned and raised on skim milk with a little shelled corn, if in winter, or on grass if they come in the spring. The first winter they are fed hay and a little grain, after that often getting no grain whatever, but sometimes being fed a little as above indicated. At two years of age they weigh from 800 pounds up according to their treatment, when they are sold for feeders, or for beef if the market is not well supplied and they are in fair condition. Practically all of their growth has been made on grass, which costs nothing to sow, cultivate or reap, and on hay and fodder which cost comparatively little. They are a by-product of the farm, turning the skim milk, fodder, hay and grass into money while their dams supply the farmer's family with milk and butter and some to spare. Local markets are good for heifers, fat cows or common steers, while the Pittsburgh market takes the finished product. The greatest need of this section is the same as that of West Virginia or any other farm territory that produces beef cattle to-day—better breeding. Too many common bulls are in use and too many of their progeny are not sufficiently well bred to sell for a good price either as feeders or as fat stock. Another need of this section is a better winter feed. The steers wintered are often lighter in the spring than in the fall and too much of the grazing season is spent in getting back the lost flesh. With silos and alfalfa the feeders will make gains throughout the winter and go on pasture ready to ripen into a higher grade of beef or to sell early in the summer before the grass cattle, of the ranges and other farms arrive in such numbers as to seriously affect the price. But with better blood, alfalfa, silage and its rich pastures no territory anywhere could produce better beef cattle or put them into market cheaper than southwestern Pennsylvania.

CHAPTER XIX

MARKETING CATTLE

This is not a matter of great difficulty in Pennsylvania. There are stockyards within the State at Pittsburgh, Philadelphia and Lancaster, while the Buffalo, Jersey City and Baltimore stockyards are easily accessible to other sections. These markets, with a large number of wholesale and smaller slaughtering establishments, make it easy to sell anything in the cattle line. The greatest cattle producing sections of the State have their periods of marketing, when the bulk of their stock goes to the slaughterer. In southwestern Pennsylvania, a bluegrass and natural grazing country, which finishes its cattle on grass, most of them go to market between July 1 and November 1, September being the month of largest shipments. In Lancaster and adjoining counties, where cattle are fed during the winter, they are marketed in the spring, more in May than in any other month. Of course some cattle are marketed every month in the year, but these are the principal periods for these sections. Many cattle are finished in distilleries in Pennsylvania, usually large numbers at one point. These are sufficient to attract slaughterers and often are not seen in market at all, going direct to the slaughter houses. Most distillery cattle are marketed in May and June. The majority are usually bulls, but of late years some heifers have been finished on slops.

SELLING AT HOME

Those who do not have a full carload of cattle will usually find it advantageous to sell at home rather than to ship. The local shipper, whose business it is to combine small lots into car lots, is a ready buyer for anything offered; so is the local butcher in many cases. The shipper is a highly useful man in any community, as he will buy any number, kind and quality and usually pays all it is worth if he deals with well-posted farmers. Not many shippers get rich at the business, which has its risks and losses as have all speculative enter-

prise. In selling to the shippers it is customary to weigh the cattle to him early in the morning before they have had water. Dishonest men, and there are a few in the cattle business, will sometimes try to "fill" their cattle before weighing, but they are soon spotted and dealt with accordingly, so that they lose money rather than gain it in the end. In some sections when cattle are weighed after having been to water a shrink of 3 per cent. is allowed the buyer, but this is not often done in Pennsylvania. The buyer protects himself in the price; the seller gets all he can. All cattle are sold by weight except fresh cows or an occasional light steer or calf, which is "lumped off" or "sold on foot" as the rather curious expression is, because scales are not handy. Every cattle raiser or feeder should have scales and use them oftener than when he sells. They tell him how his cattle are doing and help him to educate his eye so that he can estimate closely weights or gains. Scales will save their cost in a few years for any man who sells a carload of cattle a year, and they will last as long as properly cared for.

WHEN TO SELL

Josh Billings says that the time to set a hen is when the hen is ready. So as a rule the time to sell cattle is when they are ready for market, though this may be modified by the condition of the cattle, the supply of feed, the gains being made, etc. In this State cattle seldom get so fat that they can't be held a while and make further gains, provided feed supplies and market prospects make this course advisable. It is not, of course, economical for a man in a grazing country where grain is dear to hold and feed; nor is it wise for a grain-grower to feed cattle in summer when his time should be devoted to his crops. The highest markets for grass cattle are usually in July and August, before the range cattle come forward in liberal numbers. The best markets for fed cattle are usually in the spring, when most of the feed-lots of the corn belt have been cleaned up and before grasses are ready for the block.

MARKET DAYS

Every day, except Sunday, is a market day at the stockyards, but most of the cattle are usually bought on one day of the week. Many buyers go to market only on that day, which is therefore the best time to offer cattle. In shipping cattle they should be started in time to arrive the day before the market day in whatever yards they are to be sold. At Pittsburgh and Buffalo, Monday is the market day for cattle; at Baltimore and Jersey City, Wednesday; at Philadelphia, Saturday.

HOW TO SHIP

There is an art in shipping cattle as well as in feeding or handling them. The run to market may make different methods necessary, but Pennsylvania feeders have a short ship as a rule and can get their stock into the yards in good condition if they will. Cattle shipped off grass, particularly if the grass is green and full of moisture, should be put in a dry lot and fed hay 24 to 48 hours before shipment. The same applies to silage-fed cattle. Cattle on silage and grain mixed should be fed oats and hay before shipping, omitting the silage entirely. If they are shipped directly off grass they will drift badly and look hollow when they get to market—which may suit the experienced buyer but is not calculated to add to the owner's bank account. They should be moved to the shipping point slowely, if in hot weather, early in the morning, before the heat of the day. They should be shipped in a clean car, and too few in a car is usually as bad as too many on account of the jostling and bruising. In shipping to such points as Pittsburgh or Buffalo the owner should consign the cattle to himself, in care of his commission firm, and bill them through to Jersey City. A through bill sometimes helps to sell the cattle, as it is an advantage to an Eastern buyer, and it costs nothing if not used. Notify the commission man of the shipment, number and kind of cattle in it, etc.

AT THE STOCKYARDS

When the cattle arrive at the yards they are immediately unloaded by yardmen and employes of commission men, yarded and fed. The salesmen attend to the feed, the sorting if any necessary, the watering, etc., in fact does everything he can to make the consignor's shipment sell well. After feeding, the cattle are locked in pens by the stockyard company. Formerly the cattle were held off water until the morning of the market day, so that the seller could have the benefit of a good "fill," but this practice has now been properly discontinued. A good "fill" makes a difference to the seller and of course an equal difference to the buyer. But the buyer on the market, unlike the country buyer, expects to get full cattle. At that they are not so full as they would have been off the grass or feed in the country, as shipment has caused them to "drift" considerably. Soft, muggy days are bad to get a "fill" on cattle, as they will not drink freely in moist weather.

MARKET PROCEDURE

It is customary for a market to open at a certain hour, which is usually marked by a signal of some sort. This hour is usually 7 a. m. in summer and 8 a. m. in winter months. Prior to the opening

the gates are unlocked, prospective buyers may inspect the cattle, and trading begins promptly at the hour appointed—provided buyers and sellers can "get together" on the price—and continues until the stock is all sold or until it is apparent that it will be better to hold to another day. Seller and buyer enter a pen of cattle together, the price is named, a bid is made, and after more or less dickering a sale is consummated. The amount of dickering depends on the condition of the market. If the buyer thinks he can do better with another lot of cattle or with another salesman he leaves the cattle, with or without a bid on them as he may stipulate when going out of the pen. If he leaves a bid and the seller can get another buyer to raise it his obligation to the first buyer ceases; but it is not considered honorable to sell them to another buyer for the same price the first buyer bid. Of course the seller may choose to hold the cattle and not accept the first buyer's bid or any other because he thinks it too low. That is his privilege—he is not compelled to sell them until he gets a bid that suits him or that he regards as their value on that day.

As soon as the cattle are sold they are weighed, the scales being in charge of an official of the stockyards, and a ticket is issued giving number and weight of animals. This ticket is in triplicate—one copy for the owner, one for the commission man and one for the stockyards. The salesman marks the price opposite the weight on the ticket, the bookkeeper figures the amount due the owner, deducts freight, yardage, feed and commission, makes out a statement showing all items, and gives a check or draft for the amount due the owner. The cattle in the meantime have been yarded by employes of the stockyards company and their pens locked. They cannot be moved from these pens except on a pass issued by the commission firm which sold them, this pass being isued when the cattle are paid off, or at least being intended to protect the seller and the yards from such losses. But as a matter of fact there are no defaults and few disputes in the stockyards. Buyer and seller have a clear understanding of the price, and a bargain is always adhered to by both parties. Millions of dollars worth of cattle and other livestock change hands on the mere word of seller and buyer and it is all settled for the same day in cash. Commission charges are uniform in all important markets and are $13 for car-lots and 60 cents per head for odd lots or single animals.

SUGGESTIONS TO SHIPPERS

Observation for many years about the stockyards leads me to venture a few suggestions to shippers. First, get a commission man to handle your cattle, one who knows his business. Then let him alone and allow him to sell them according to his best judgment. If he cannot be trusted to sell them for the high dollar he is not the right man to employ. Some owners set a price limit on their cattle which no seller can reach. This causes the owner to lose money because his salesman loses opportunities to sell the cattle to best advantage on the market. Cattle often sell late in the day for less than was bid on them earlier because the owner thought he knew more about the market than the man he had employed to handle his cattle on that market and had tied the salesman's hands. Some owners are disappointed because their salesman does not show their cattle to every buyer who comes along. The salesman knows the buyers as a rule, knows the class of cattle they will buy and very properly refrains from showing them cattle on which there is no chance of making a sale. It's no use to show a man who always buys 1,000 to 1,050-pound steers a lot of 1,300-pound steers. Some cattle owners try to sell their stock themselves and have done so sometimes when their representative had already sold it for more money. As a rule commission men are hard workers for their clients and do their level best to sell their stock to best advantage. And they do better when not hampered by limits, or bothered by many suggestions from the owners. Prospective shippers should always write their commission house for information about the market, which is furnished free and is often helpful.

MARKET CLASSES OF CATTLE

Cattle are classified in market according to their kind, their condition and the use that is to be made of them. The buyer usually makes a mental estimate of their dressing percentage, which means the amount of beef they will yield; their condition, which means the class of beef they will produce; their weight, which regulates the size of the cuts of beef; and he also considers their hides, whether branded or unbranded, because branded hides must be sold at a discount. In all these matters the important points are the breeding of the cattle, whether straight, level backed, not coarse about the head or rough, or heavy boned; their condition, whether well fattened as judged by ribs, by tail-head and cod, indicating quality of beef they will make; their weight, as to whether they will make cuts not too heavy or too light for his trade; their fill, whether they will be good pound-makers, that is, will dress a high percentage of beef. Horns are also considered and their presence knocks about 25c. per cwt. off the price of fat steers. Market topping steers at the Pittsburgh yards dress around 60 per cent. when shipped from the feed-lot to

market, but they do not often exceed this. In summer and fall, when no dry-lot cattle are in the market, the best steers in these markets rarely yield more than 58 per cent. of beef and often not that much. Years ago the weight of the steer was some criterion of his standing in market. This is no longer true. Market topping steers may be of any weight or age. Usually steers of 1250 to 1350 pounds sell highest in Pennsylvania markets, but when light cuts of beef are in demand a load of prime yearlings may sell at the top.

HEAVY STEERS

Steers weighing 1,300 pounds or over, are usually purchased by slaughterers who supply hotel, club or kosher trade. Hotels and clubs want heavy cuts, and as the orthodox Jews use only the forequarters of the animal they require some weight in order to get good sized cuts of beef. Not many steers are now marketed in Pennsylvania that weigh 1500 pounds or over, and the percentage that weigh 1400 pounds or over is small. The best time to market extreme heavy weights, if they are thoroughly finished or "ripe," is the first two weeks in December, when buyers are looking for Christmas cattle. Coarse heavy steers are usually hard to sell, not many buyers wanting them unless at relatively low prices. Most of the good fat steers marketed in Pennsylvania weigh 1200 to 1300 pounds. Well finished, smooth and blocky steers of these weights will sell as high as any most of the time and often higher than the extreme heavy weights. All of these steers are graded according to their quality and condition, extra, good, fair and coarse.

BUTCHER STEERS

Butcher tesers are those taken by city and country slaughterers to sell to the trade which requires less weight and less waste fat in cuts than are found in the heavier carcasses. These steers range in weight from 1150 lbs. down to 800 lbs. Choice butcher steers are well-finished and sell pretty close to the heavier and riper steers. Handy butcher steers are those which weigh 1000 to 1050 lbs. as a rule, are fairly fleshy and suit the ordinary slaughterer. Light butcher steers, below 1000 lbs., lack flesh or fat and go to the trade which takes a lower grade of beef than that made by the heavier and fleshier steers. Yet weight is no criterion, these are merely the usual weights of cattle which are used by the slaughterers to provide different qualities of beef for their trade. Light but fat steers will sell as well as weightier steers and sometimes better. Flesh is the real criterion of values.

YEARLINGS

Yearlings are cattle finished for the block before they are two years of age. They may be ripe and sell close to the top of the

Fig. 34. A PRIME BUTCHER COW

Her carcass is sold for beef, and it is cheaper than steer beef, though there is greater waste in it—more waste fat and lower dressing percentage than a steer in same condition.

Fig. 35. COMMON CANNER COW.

She is converted into canned or tinned beef—the favorite army ration.

Fig. 36. A PRIME BUTCHER HEIFER
Her carcass makes good beef.

market, or they may lack flesh and sell as ordinary light butcher steers.

FEEDERS

Feeders do not appear on Pennsylvania markets nowadays to any extent except at Lancaster. Most of the light steers of good enough quality for feeders are sold in the country, the culls come to market and go as common butcher steers. Good feeders are cattle of 800 to 1000 lbs., straight and well-bred, but lacking flesh. Most of those sold on Pennsylvania markets weigh less than 900 lbs. Stockers are usually of 500 to 750 lbs., and thin.

COWS

Cows cover a wide range in quality and price. Fat cows sell to butchers who use their carcasses same as those of steers. Thin cows go to canners or sausage makers. In recent years feeders have taken out a good many thin cows to graze or to feed on silage and grain, returning them to market when fat. Fresh cows of course go to dairymen who fatten them and milk them at the same time, selling them to the butcher when they fail in milk and are fat. Springers if close to calving go the same way.

HEIFERS

Heifers are not discriminated against by slaughterers as much as formerly. Good fat heifers will sell within 50@75c. per cwt. of steers of the same quality. All heifers go to the block except an occasional bunch of light ones which may be taken by a feeder. These last are known as stock heifers.

Bulls are sold for beef or bologna according to their condition. Good fat bulls go for beef; thin and dairy bred bulls are usually converted into sausage. Stock bulls are the light and young bulls taken to breed to dairy cows whose calves are not to be raised. Cheapness is usually their greatest merit.

The following are classifications of cattle at Pittsburgh market as recorded on livestock journals:*

QUOTATIONS

Extra corn-fed steers,	$9 25	@	$9 50
Choice fat steers, 1,200 lbs. or over,	8 75	@	9 00
Good to choice fat steers, 1,200 lbs. or over,	8 50	@	8 75
Fair to good fat steers, 1,200 lbs. or over,	8 00	@	8 35
Plain weighty steers,	7 75	@	8 00
Choice fat handy steers,	8 25	@	8 75
Good fat butcher steers, 1,100 to 1,200 lbs.,	8 00	@	8 25
Fair to good, do.,	7 50	@	7 85
Good fat butcher steers, 1,000 to 1,100 lbs.,	7 50	@	7 85
Fair to good, do.,	7 25	@	7 50
Ordinary to fair, do.,	6 75	@	7 25
Common butcher steers,	6 25	@	6 50
Common light steers,	5 50	@	6 25

*The National Stockman and Farmer. Pittsburgh, Pa.

QUOTATIONS—Continued

Good to choice heifers,	7 25	@	7 75
Fair to good heifers,	6 25	@	7 00
Common to fair heifers,	5 25	@	6 25
Light thin heifer stuff,	4 25	@	5 00
Good to choice fat cows,	5 75	@	6 25
Comon to fair cows,	4 25	@	5 00
Fair to good fat cows,	5 25	@	5 75
Thin cows,	3 50	@	4 00
Canners,	2 75	@	3 25
Choice butcher bulls,	5 75	@	6 00
Good to choice butcher bulls,	5 25	@	5 75
Fair to good bulls,	4 75	@	5 25
Common to fair bulls,	4 25	@	4 75
Thin light bulls,	3 75	@	4 25
Choice fresh cows,	60 00	@	65 00
Fair to good fresh cows,	50 00	@	60 00
Common to fair fresh cows,	25 00	@	45 00
Springers,	25 00	@	55 00
Veal calves,	7 50	@	10 50
Heavy calves,	5 00	@	7 50

QUOTATIONS

*Choice to prime,			
Good to choice, 1,300 to 1,350 lbs.,	9 10	@	9 25
Tidy, fat choice steers, 1,000 to 1,100 lbs.,	8 50	@	9 00
Good, 1,200 to 1,300 lbs.,	8 40	@	8 90
Handy butcher steers, 900 to 1,050 lbs.,	7 60	@	8 25
Fair to good medium steers, 1,000 to 1,100 lbs.,	7 00	@	7 30
Common to fair steers, 900 to 1,000 lbs.,	6 00	@	6 90
Plain light steers, 600 to 800 lbs.,	4 75	@	5 75
Choice to extra heifers, 1,000 to 1,200 lbs.,	7 00	@	7 50
Good to choice heifers, 800 to 1,000 lbs.,	6 00	@	6 60
Fair to good heifers, 600 to 900 lbs.,	5 25	@	5 75
Common to fair heifers, 600 to 800 lbs.,	4 50	@	5 00
Choice to extra butcher cows,	5 75	@	6 00
Good to choice butcher cows,	5 00	@	5 50
Medium to good butcher cows,	4 00	@	5 50
Medium to good butcher cows,	4 00	@	4 75
Fair to medium butcher cows,	2 75	@	3 75
Common to fair cows,	2 50	@	2 75
Dairy cows, common to good,	2 50	@	5 25
Choice to extra milch cows,	50 00	@	60 00
Fair to good milch cows,	20 00	@	40 00
Choice to extra butcher bulls,	5 75	@	6 25
Good to choice butcher bulls,	5 25	@	5 75
Medium to good butcher bulls,	4 75	@	5 25
Common to fair bulls,	4 00	@	4 60
Common to good fat oxen,	4 50	@	5 00

*Pittsburgh Daily Livestock Journal.

CHAPTER XX

DISEASES OF CATTLE*

STERILITY

This is the bugbear of the breeder of fancy stock. Frequently some of his most highly bred animals fail to breed, much to his disappointment and financial loss. The causes leading to this condition are either constitutional or local. Among the constitutional causes are long continued inbreeding, cows of the beef breeds made excessively fat for show purposes, insufficient exercise, and the keeping of cattle under highly artificial conditions. Sterility resulting from any of these causes operates in the same way in both male and female. The remedy in either case is obvious—do not follow long continued inbreeding, feed moderately, and in the case of the bull give plenty of exercise.

The local causes in cows are various. Leucorrhea frequently follows in sufficient removal of the placenta. Irrigation of the womb with a one-half of one per cent. solution of lysol should be used until the discharge ceases, and this should be followed by an alkaline solution consisting of a teaspoonful of borax to a quart of warm water. However, in the cow the most frequent local cause of failure to breed is occlusion of the os uteri, or mouth of the womb, following an injury during a previous calving. Dilators are sometimes used to overcome this evil. The index finger of the right hand is preferable for the unskilled operator. The finger smeared with vaseline is used with a rotary movement until the opening to the womb is sufficiently dilated. Solid extract of belladona applied to the os a few hours previous to operating helps to dilate the opening. Following the operation, a good flushing with very warm water followed by the alkaline solution is good practice.

DIFFICULT PARTURITION

Too much haste should not be made in cases of difficult parturition in a cow. Under normal condition parturition is accomplished in a few minutes by a mare. In cows the operation is more prolonged. She may be in labor for twenty-four hours and then give birth to a live healthy calf. In a normal parturition for a cow the calf is presented to the external opening with both front feet and the head nose first. In exceptional cases the hind feet are presented first. Too much force should not be used by an inexperienced person in pulling on a foetus presented in abnormal positions as it may become wedged into the genital passage in such a way that it is impossble to remove it without causing serious damage. In many cases where the calf is presented in an abnormal position it may be forced back and placed in a proper position for easy delivery. This is usually impossible except for an experienced operator. In some cases even the most experienced practitioners have unusual difficulties in delivering the young that are presented abnormally. The best possible assistance should be procured for cows if unsuccessful labor pains have continued for twelve hours or more.

RETENTION OF THE FOETAL ENVELOPES IN THE COW

Causes are abnormal adhesions between the maternal and foetal placenta, cold draught or anything liable to produce a chill, stopping the labor pains. There are many instances where it is impossible to decide what causes the retention. But there are certain precautions that should be taken by the owner. The giving of a teacupful of scalded flaxseed once a day for a few days previous to parturition and continuing for three days after is of use to ward off this trouble; also to blanket the animal immediately after calving tends to eliminate a chill, and the extra heat will cause the labor pains to continue, being careful to keep the animal out of all currents of air. The application of the hot pack over the loins is of service. The use of the hot "flat iron" can be used over a blanket, ironing along the back is highly recommended. And in no case give cold drinks until the envelopes are discharged. If in three days they are not passed then they should be taken away by a veterinarian. The tying of weights to the mass, or pulling on the external mass should not be done as it is likely to break the portion off anterior to the cervix, then the cervix soon closes making it a most difficult task to properly remove the envelopes. They should not be removed by hand before the third day without special reasons as cows are as a general rule not endangered by leaving the envelopes this length of time, but if there is great straining or the external mass is large then they may be removed at once, but most of the time nature performs the re-

moval about the third day or before and in a better manner than we can do it. If they are not passed by the third day it is better to have them removed. If certain precautions are observed they can be removed without danger to the animal. First, we should inject into the uterine cavity about two quarts of a weak antiseptic solution, such as one-half of one per cent. solution of lysol, then after the removal wash out the uterus with about two quarts of the same solution. The next day if there is any discharge the uterus should be flushed out with a solution containing a teaspoonsful of baking soda (bicarbonate of soda) to two quarts of water, and this can be repeated each day until the discharge ceases. This injection can be made best by using a piece of hose about two feet long with a tin funnel attached to one end, holding the funnel above the back allowing the solution to run into the cavity by gravity. The hose can be passed into the maternal passage about nine inches.

The removal of the foetal envelopes in cases of abortion is too often neglected. This in many cases leads to sterility.

In case of a retained after-birth the milk should not be used for human food till the membranes have been removed and all discharge from the vagina has ceased.

MILK FEVER

The premonitory symptoms of milk fever are restlessness, drooping ears, stupor, staggering gait, the cow ultimately loosing control of her limbs and falling heavily on her sternum, her head turned toward her flank.

A few years ago milk fever or parturient paresis was the most dreaded and the most fatal disease in the category of bovine diseases. But few of the cows attacked during the first day or two after parturition recovered. To make matters worse these cows were usually in their prime and the best milkers in the herd. Various methods of treatment were used. The iodide of potassium treatment reduced the mortality considerably but it was only with the adoption of the oxygen treatment, and later by the simpler method of inflating the udder with sterilized air was it reduced to a minimum.

The milk fever outfit for the inflation of the udder can be purchased at any veterinary surgical instrument store and can be used by any intelligent person. The directions are briefly as follows: Cleanse the udder with soap and water and disinfect teats with a five per cent. solution of creolin. Put a clean towel under the udder, insert the tube in one of the teats, have an assistant work the bulb until one quarter is thoroughly inflated. Tie a tape around the teat to retain the air. Follow the same method with the other three teats. Repeat in two hours if necessary.

The cow ought to be propped on her breast with bags filled with hay or straw, and her head supported by a halter tied to a beam over head. After the cow is on her feet, if necessary, the following medicine can be given: one pound of epsom salts, one once nitrate of potash, one ounce ginger, warm water, 1 quart.

CONTAGIOUS ABORTION

Contagious abortion is caused by a microorganism which was first recognized by Prof. Bang, of Denmark, and verified by the Commission appointed by the late King Edward to study the disease. The same organism was recently isolated from several herds by Dr. K. F. Meyer, at the laboratory of the State Livestock Sanitary Board, thus proving the fact that has long been suspected,—that true contagious abortion exists in this State. The disease is widespread in this country and causes extensive losses annually to our livestock.

The organisms that cause the disease are known to exist in the uterus, foetus, foetal envelopes, after-birth, and in the discharge from an aborting cow shortly before and some time after abortion. Infection is supposed to take place principally through the digestive tract. A few drops of infectious material on grass, hay, grain, bedding, etc.,

is sufficient to produce abortion in a susceptible animal. Infectious material may be carried by the bull. Natural immunity is produced in most cases after the first and nearly always after the second and third abortion. Patent medicine has often received undue credit from this fact. In herds where the old members have become immunized the heifers and newly purchased cows usually abort.

Up to the present time no specific treatment has been discovered that will cure the disease. Thousands of dollars are spent each year by stockmen for numerously advertised patent medicines which are guaranteed to cure the disease but are practically worthless, as can be shown by many who have given them a trial. According to the test and best authority prophylatic measures are extremely useful and should be faithfully followed until better methods are discovered. In herds free from the disease care should be exercised in not purchasing cows that are affected. Determine, if possible, whether the previous calf was carried to full term. There are no positive physical symptoms of the disease. Herds are often affected by allowing neighbor's cows to be served by the herd bull. For heifers, it is best, in all cases to use a young bull that has not been exposed to contamination.

Where the disease is known to exist in a herd, the cows that have aborted two or three times may be considered immune. The balance of the herd may be considered as infected. Abortion may take place any time during pregnancy, yet from the fifth to the seventh month is the most common time. If symptoms of abortion are recognized the animal should be isolated and kept isolated as long as there is any discharge from the genital organs and not returned to the bull for about three months. She should not be allowed to walk through the stables, yards or pastures till the discharge has entirely disappeared. With proper treatment this should occur in from two to three weeks.

After the cow has aborted, the foetus, foetal envelopes and afterbirth should be disinfected and placed out of reach of chickens, dogs, cats and susceptible cattle. They can be well covered with quicklime and then boiled, buried or burned. This precaution should be taken whether the cow aborted on the pasture, in the yard, or stable. She should then be isolated in a stall, the floor kept well covered with a saturated solution of blue stone. The droppings, soiled bedding and refuse food should be treated in the same manner and placed in a box or tank that can be kept closed. It should then be burned, if possible, or removed to some place of safety out of the reach of animals.

At first she should be injected twice, then once daily, with about six quarts of warm lysol solution,—one ounce of lysol to six quarts of water. Creolin or other coal tar products should not be used for this purpose on account of straining caused by them. A bucket with a faucet in the bottom and about six feet of rubber hose about five-eighths of an inch in diameter attached to it is the most convenient method for administering the solution. The bucket can be hung above the cow and the hose inserted well into the vagina. If more than one animal is to be injected the operator should be provided with two rubber hoses. After one has been used it should be removed and immersed in a strong antiseptic solution and allowed to remain for about ten minutes to destroy any infection that may be on it. It is best to keep the hose in an antiseptic solution when not in use. After having used the lysol solution as long as is necessary as a vaginal douche, bicarbonate of soda should be used in the same way, once daily for three days and again immediately preceding the next service.

It is important also to wash the tail, hips and thighs of all cattle in the infected stable once daily with a strong solution of lysol. One and one-half ounces of lysol to six quarts of warm water can be used for this purpose. Such washing should be done soon after the morning milking. The stable should be well aired to prevent the odor of disinfectants in the next milking.

THE BULL

The long hairs around the prepuce of the bull should be clipped and this region well washed with a one per cent. solution of lysol before, and immediately after each service. It is not considered necessary to inject the sheath of the bull. If done, however, the weaker solution of lysol (one-half of one per cent.) should be used.

Carbolic acid has been recommended and for the present it is advisable to use it. It can be given in either or both of two ways, as follows: Two and one-half drams of a two per cent. solution of carbolic acid in water is given hypodermically once each week from the fifth to the seventh month of pregnancy to susceptible animals. Second, the carbolic acid may be given as a drench by the mouth during the same period. For this purpose one quart of a one per cent. solution is given once a day from the fifth to the seventh month of pregnancy. Where the above precautions, prophylaxis and treatment can be thoroughly followed, fairly good results may be expected.

The State Livestock Sanitary Board proposes to carry on a vigorous campaign against this disease. You can assist by notifying us promptly of any cases of abortion in your practice.

DIRECTIONS FOR COLLECTING AND SHIPPING SPECIMENS

Where pregnant animals die or are slaughtered that are suspected of being infected with contagious abortion the entire uterus should be removed and it, with its contents, sent to the laboratory. Where animals have aborted the foetus, foetal membranes or afterbirth should be collected and sent promptly to the laboratory. Such specimens should be well wrapped in cloth saturated with a bichloride of mercury solution 1-1000. This should then be packed in a box or bucket and surrounded with saw dust, in warm weather cracked ice should be mixed with the saw dust but this precaution is not necessary in cold weather. The box can be shipped C. O. D. to the Laboratory, State Livestock Sanitary Board, 39th and Woodland Avenue, Philadelphia. Mark the box with name and address of sender and also "Perishable! Rush!"

Those who assist in this work by complying with the above described plans will be kept informed in reference to the progress that is being made or anything new in the way of treatment that may be discovered.

MASTITIS

This condition is commonly spoken of as garget. It is an inflammation of the udder due to a wide range of causes. The inflammation may be so slight that it will not attract the attention of an ordi-

nary observer, or so extensive that all tissues of the udder are involved and the life of the patient endangered. This disease may occur any time during the period of lactation. An extensive oedema is often seen in heifers before calving. In most cases it disappears a few days after the calf is dropped. This condition is at times physiological and no treatment is required except the massage naturally given by the calf.

Among the many causes of mastitis might be mentioned bruises from kicks, blows or tramps from mother cows, chilling, irregular milking and especially excessive bagging for sale or show purposes. It may result from infection which gain an entrance through cuts, cracks or wounds. Some forms of infection may even pass through a healthy teat duct. A most obstinate and extensive inflammation of the udder is frequently caused by the improper use of a teat tube or by operations performed by careless or incompetent operators in an endeavor to open the external orifice of the teat so that the animal can be milked more easily.

In some cases mastitis is due entirely to contagion and may be carried from animal to animal on the soiled hands of the milker. This form of garget is seldom seen in Pennsylvania, yet a few cases have been observed and extensive losses have resulted from it in each case. Tuberculosis or actinompcosis of the udder are chronic forms of inflammation that are not seldom seen. At times it is impossible to discover the cause of mastitis.

Too little attention is frequently given to the treatment of udder troubles. A valuable cow often becomes worthless through neglect or improper treatment. In every case mastitis should be considered a serious condition and suitable treatment begun at once and faithfully continued. Treatment in old chronic cases is usually worthless. As a general rule a cow afflicted with this disease should be placed under treatment as soon as the condition is observed. She should be put in a warm, dry well ventilated box stall with plenty of clean bedding, milked about four times in each twenty-four hours, and given food which is nourishing but not of a nature to produce a large flow of milk. Hay with a small allowance of grain is considered best.

Frequent or continuous fomentations with hot water are especially useful. Medical treatment should be carried out in accordance with instructions from one qualified to prescribe it. In cases of chronic inflammation of the udder the cow should be submitted to a tuberculin test. The milk from a cow afflicted with any form of mastitis should be rejected till all evidence of inflammation has passed. Many cows give milk showing a high bacterial count even for months after apparent recovery. Cows that have lost one or more quarters and those that have hard fibrous painless areas in the udder should pass a tuberculin test before their milk can be considered safe for food without pasteurization.

CHOKING

This accident is caused by an unsuccessful attempt to swallow some object like an apple or turnip. It may stop in the pharnix, cervical or thoracic portion of the oesophagus. The nearer the throat it stops the more pronounced are the symptoms. When choked the cow stands back and coughs, saliva flows from the mouth and nose. The cough is frequent if the object is near the throat. The intermittent discharge of saliva from both mouth and nose would lead one to suspect choking, then bloating soon follows.

In case of doubt one should examine the left side of the neck along the passage of the gullet and try to find the object. It is best to give a drench of about one-half pint of flaxseed oil. If the choke entirely stops the passage the oil will be regurgitated and pass out of the nose and mouth. If the object is in the upper part of the neck an assistant may press it toward the throat and by placing a gag in the mouth to prevent the animal from biting it may be reached with the hand and removed. If the object is further down the neck it is best to try and force it on into the stomach. A piece of garden hose six feet long may be used for this purpose. Much care should be exercised in trying to force an obstruction. Usually an inexperienced person should not attempt to do it for the reason that the oesophagus is easily torn or ruptured. The obstruction should be removed as soon as possible, yet unnecessary haste should not be made. It would be safer to wait twenty-four hours for skilled assistance than to allow an inexperienced person to attempt to remove it at once. Such operations as attempting to force the obstruction down with a fork handle or crushing it in the oesophagus should not be permitted.

BLOATING

The symptoms of bloating or distension of the rumen with gas are too patent to require much description. The left side over the region of the paunch in acute cases is enormously swollen, rising to a level with the transverse processes of the lumber vertebra. There is oppressed breathing, dribbling of saliva from the mouth and eruction of gas. Its causes are various. A change from dry to green succulent food, over feeding with grain, closure of the oesophagus by chok-

ing by preventing the escape of gas will cause tympanites or bloating. Immediate relief ought to be given otherwise the animal may die. This can be accomplished by tapping the rumen with a trocar and canula. The point chosen being the left side equi-distant from the last rib and hip bone, and the same distance from the lumbar processes. The canula ought to be left in position until relief is afforded, and this treatment followed by a purgative composed of one pound of epsom salts, four ounces hyposulphite of soda, and one ounce of ginger dissolved in one quart of warm water. Less urgent cases of bloating may be relieved by giving four ounces of hyposulphite of soda dissolved in a pint of boiling water, adding when cool, one-half ounce of carbonate of ammonia.

CALF SCOURS

This term is applied by farmers and livestock owners to two different diseases. One is purely local affection confined to the intestines. The other is a form of blood poisoning, which affects not only the intestines but other parts of the body. The first disease is the most common. When it occurs in sucklings it is due to over-feeding; this happens when the calf is kept away from the cow too long and then permitted to take too much milk. Calves fed on milk from buckets or self-feeders are affected with this form of scours when the milk is fed cold or in too great quantity or when the feeding vessels are not properly cleaned; the latter is the most common cause. In weanlings the disease results from sudden changes of food and from over-feeding. Exposure to cold and dampness, as occurs when calves are kept in dark, unlighted, unventilated stalls, is a very common accessory cause in the case of both sucklings and weanlings. The affected calf may show some dullness or depression for a day or two before the diarrhea appears, but the latter is usually the first symptom noticed, especially after the tail and buttocks have become soiled. The bowel discharges are at first slimy and frothy, usually yellow in color with a cheese-like odor; later on they become watery and brown or black in color. The appetite may or may not be affected. After a time the calf becomes dull and sleepy, gradually loses flesh and strength, the hair becomes dry and bristling, the nose dry and the appetite disappears. There is little if any rise of the temperature.

It is difficult to outline a treatment that will be suitable to all cases, but that given below will be found of benefit in most cases. It is of more importance to the livestock owner to study the cause of disease and the conditions under which they occur and to use this information to avoid them rather than to endeavor to learn how to treat the animals after they have become diseased. In most instances when the animal is of any value it will be more economical to employ a competent veterinarian to prescribe treatment.

In the case of sucklings, proper attention to feeding and stabling will be usually sufficient, but it may be advisable to give about one and one-half to two ounces of castor oil, with a half ounce of lime water, to remove the irritant substances from the bowels. For milk fed calves the best treatment is formalin. One-half ounce of formalin should be mixed with fifteen and one-half ounces of distilled water, and one teaspoonful of this solution should be added to each pint or pound of milk fed. The amount of milk fed should be reduced about one-third.

Weanlings should receive two or three ounces of castor oil to one and one-half ounces of Gregory's powder, according to size, and after this has acted two teaspoonfuls of paregoric every three hours. It is not uncommon for farmers to give raw eggs, shell and all, to calves affected with this disease. The albumen in the egg will exert a soothing effect upon the inflamed bowel, but powdered chalk would be equally as effective as the crushed egg shell and will not be so likely to add to the irritation.

The other disease is commonly called calf cholera. This is caused by bacteria which do not remain in the bowels but enter the blood stream and reach other organs. It is an infection of new born animals, occurring within the first twenty-four to forty-eight hours, and in most cases causing death in two or three days. The affected animal has a high temperature, is greatly depressed and shows great weakness. The diarrhea appears on the first or second day, is at first slimy and later watery and has a very foul odor. The color of the discharges is yellowish in the beginning but later grayish white. On account of the latter symptoms the disease is sometimes called white scours. This disease is best treated by prevention. When it appears on a farm the stall where the calf was dropped and other stalls which may have been occupied by it should be thoroughly cleaned and disinfected, and cows calving subsequently should be placed in another part of the barn if possible, but in all events should be given a thoroughly clean, disinfected stall with clean bedding. When the

calf is dropped the naval cord should be washed with a disinfectant solution and then painted with tincture of iodine. It should not be allowed to suckle an unclean udder or to lick soiled walls or bedding. This disease is very infectious and a stall which has been occupied by a calf infected with it may infect another calf several months later. Infection may also be transmitted by the hands of attendants when calves are fed from the bucket. Little can be expected from medical treatment after the symptoms of the disease have disappeared, because by that time the bacteria have entered the blood stream and been carried to several other organs in the body. Castor oil and one and one-half to two ounces, paregoric one to two drams, salicylic acid three to seven grains and brandy in teaspoonful doses are recommended.

There is another form of this infectious calf scours which occurs in calves two to five weeks old, but this is rather uncommon. The symptoms, course of the disease, mortality and treatment are the same.

PARASITES

The parasites infecting our domestic animals are numerous and the space allotted here to this subject will permit of but a brief review of a few of the more important. While some of the parasites do but little harm, others may be of such serious injury as to be of vast economical interest to the stock grower, not to speak of their importance in their relation to animal food products and public health. The external parasites, such as flies and gnats, may do harm by their annoyance, but the tortures of their bites, causing an unthriftiness and loss of milk production in the dairy, or, indirectly, they may be the carriers of infection, transmitting a specific disease producing organism from the body of one animal to another, as is exemplified in the tick which is the intermediate carrier of the organism producing Texas Fever. Internal parasites may cause injury by mechanical obstruction, by perforation, by the irritation and inflammatory conditions set up by their presence, or, if in large numbers, by depletion of the circulatory fluids.

As a general statement it may be said that animals kept under poor conditions as to cleanliness of body and surroundings and those which are unthrifty from any cause are more subject to parasitic invasion. Close, crowded quarters of course favor their transmission from animal to animal, and it is during the winter months when animals are most in stables that parasitism meets the conditions most favorable for its propagation.

RING WORM

This is a highly contagious skin affection caused by a vegetable organism (Trichophyton tonsurans), which belongs with the Fungi- Young animals are mostly affected, the parasites invading the hair and follicles, generally in the region of the head and neck producing changes in the root and shaft which render the hair brittle, easily broken up, and resulting in the entire denudation of the affected part. By this process and by the spreading of the spores we have the resulting round bald spots which characterize the disease. The skin of the invaded area becomes inflamed, there is more or less vesication with exudation and crust formation, from the deep layers of which material may be obtained which will reveal under magnification the organism which is the cause of the disease. The affected patch does not spread indefinitely, but after reaching its maximum diameter will spontaneously disappear, the fungus having expended its activity in that area. The animal is not then cured, however, as the spores are spread by rubbing to other parts and new patches are formed which may coalesce and form larger denuded surfaces.

The average duration of ringworm in the ox is six weeks to three months by which time it may gradually diminish without medical interference, though in some cases it is more persistent, this especially being the case in calves. The seriousness of the affection is principally in its contagiousness, as it may readily affect an entire herd or may be conveyed to man. Excepting in very young animals, it does not seem to be accompanied by serious constitutional disturbance, poor condition being an accompaniment, probaly more as a predisposing factor than as a consequence of the affection.

Treatment should aim at the limitation of its spread by isolation and care that stable utensils, such as brushes and clothing used about an affected animal, are not brought into contact with others in the herd. Posts that have been rubbed upon should be removed or thoroughly cleaned and whitewashed. Individual cases may be treated by loosening and removing the scurf from the affected parts with soft soap and warm water, followed by the repeated application of pure tincture of iodine.

LICE

The lice comprise those insect parasites of the skin which are wingless but which differ from fleas in that they do not jump and only by accident quit their host. The lice belong to the order Hemiptora and are divided into two families which comprise those which suck blood and the biting lice. The former can be readily distinguished from the latter by their somewhat larger size and by their mouth-parts which project prominently in front of the head. The biting lice are smaller, head not elongate, and broader than the thorax, with mouth parts beneath and not visible when looking upon the parasite dorsally.

Both of these families are found upon the ox, the sucking lice furnishing two species, Hematopinus eurysternus and H. vituli. By the penetration of the skin with their sucking mouth-parts these produce much the greater irritation and pruritis; they seem to prefer the parts where the hair is long and least accessible to licking, such as the pole, base of ears and crest of neck. Their presence in the ox, as in all animals, is manifested by indications of itching which is proportionate to the number of parasites present, and by the presence of eggs upon the hair which contains much cutaneous debris and is often harsh, broken, and rubbed off in patches. If the hair is parted in the regions mentioned the parasites may be found, eurysternus, or the "broad-nosed ox-louse," having the large bag-like abdomen, while vituli, which is more often found upon calves, is smaller and narrower. The one species of biting louse, Trichodectes scalaris, inhabiting the ox, may be found alone or in cohabitation with the sucking lice upon the same host. These are much smaller and may be seen crawling out upon the hairs, often clinging tenaciously to a single shaft. As they do not prick the skin they set up a much less serious irritation than the blood-sucking lice. They do not attack the skin substance but live upon the epidermal products and debris, confining themselves less to the deeper parts than do the larger genus.

As to treatment, the general principles applicable to all parasitic skin invasion will apply here. The season of the year when animals seem apt to be the harborers of lice is toward the close of the winter months and early spring. When the animals get away from the conditions of stabling, bedding and closer contact with each other such parasites have a less favorable opportunity for propagation. Where a number of cattle have been invaded, there should be a general cleaning up with burning of litter and liberal applications of whitewash. Affected animals may be sponged with a five per cent. solution of creolin, or decoctions of tobacco stems, or quassia may be used in the proportion of four ounces of either to the gallon of water which is allowed to boil for thirty minutes.

WARBLES

The fly responsible for these familiar tumors upon the backs of cattle belongs with the same family as the horse and sheep. It is about the size of the honey bee, black, hairy, and has gray bands upon its back running from before to behind. About the middle of the summer it deposits its eggs, generally upon the hairs about the lower part of the legs, the animal by licking conveys the larvae to its mouth. From here they reach the oesophagus where they may be found in late fall having undergone development to the length of half an inch or more. At this stage they leave the digestive tract and wander through the intermuscular and subcutaneous tissues to a place beneath the skin in the region of the back. Here the larva

undergoes further development, forming a nodular tumor about an inch in diameter at its base, upon the summit of which there is an opening that becomes larger as the grub develops. In the late spring, when the larva has grown to nearly an inch in length by one-half an inch in thickness, it leaves the tumor through the opening in the summit and passes to the ground into which it burrows for an inch or two and here passes through its pupal stage from which it emerges as the adult fly about six weeks later.

This is the life history of the species of warble-fly found in America (Hypoderman lineata) most common in the Southern United States. Its injury to its host cannot be said to be of a serious nature; if in large numbers they may through irritation cause an unthriftiness but there is perhaps a greater commercial loss on hides of animals slaughtered during the grub season, due to defects caused by the perforations of the skin.

There is little to be recommended in the way of treatment; they may be sometimes removed by squeezing upon the base of the tumor, causing the grub to extrude through the opening at its summit.

VERMINOUS BRONCHITIS

This is a condition causing in certain localities extensive losses in calves, though older cattle may harbor the worms, rarely, however, with the same fatal effect. Two species or verminous parasites infest the bronchi of cattle—Sprogylus micrurus and Strongylus pulmonalis. The former is a white thread-like worm two to three inches long, the tail of the female terminating in a sharp point, while the last named is somewhat similar in shape but smaller, rarely exceeding one and a half inches in length.

The life history of the lung worms of cattle has not been fully traced. It is probable that the eggs and embryos expelled in coughing live for a time in moist conditions where they undergo changes which again adapt them to live in the bronchi of a bovine host. Seasons of overflow, wet lands, and ponds all favor infestation, which may be contributed to by low condition and scanty feed.

The symptoms brought about by the presence of these parasites are those of bronchities, or it may be pneumonia. A frothy liquid contaminated with the worms or their ova drips from the mouth. For a week or two there may be only a slight cough which, however, becomes more frequent and distressing. The appetite is lost and there is a rapid falling off in strength and condition. The animal becomes hide-bound, with staring coat and scrufy skin, hence the name, "Husk," or "Paper Skin," which is commonly given in this disease. It may die from suffocation in a paroxysm of coughing, or perhaps wander off alone to be found later in some obscure place without the strength to rise to its feet and in a miserable state of marasmus from which it may die. Death may occur at any time from asphixia, due to the blocking of the bronchi with worms, while in milder cases its course may run for a period of two or three months.

Preventive measures consist in keeping the calves from pastures and lots previously occupied by infested animals. Swamp lands and those containing ponds are especially liable to be contaminated, and running water may carry infection from one locality to another. Fields that have been infested should be ploughed up and cropped for several years, or they may be pastured for the same length of time by horses and sheep which do not harbor the lung worms of calves. As the worms find less favorable conditions in thriving, well-fed animals, calves should be well nourished by a liberal grain diet. A combination of tonic and vermifuge treatment may be attempted in individual cases. Tracheal injections are perhaps most effective but require the skill of a veterinarian in their application.

ANTHRAX

Anthrax is a dangerous disease affecting horses, cattle and sheep. Dogs, hogs and poultry are not often attacked by it yet it is easily transmitted to man.

The cause of anthrax is a specific organism known as anthrax bacillus, which lives in rich soil and multiplies in the blood of susceptible animals. Within the rod-shaped bacillus a spore is found which is difficult to destroy and may live under certain conditions for years, and is capable, after that length of time of producing the

disease. This is the reason for burning or safely burying the carcass of an animal that has died from anthrax. Fields in which animals have died from anthrax are known to remain infected for years and susceptible animals grazing over the infected areas have contracted the disease and died. One should bury or burn the carcass of an anthrax victim on the spot upon which it died and then thoroughly disinfect or saturate straw wth kerosene and burn over the exposed surface. The grave should be fenced off to prevent the spread of any infectious material that was not destroyed.

Animals may become infected in the following ways: The germ may be taken into the body with the food and produce infection even through a healthy mucous membrane, or they may gain an entrance through scratches, bites, or other wounds. The symptoms vary considerably depending upon whether infection took place through the skin, intestines or lungs. The animal may be attacked suddenly and die within an hour or after being sick for a week. The disease begins with a high fever. The temperature may reach 106 or higher and remain high till a few hours before death. The pulse beats seventy-five to one hundred or more per minute accompanied by chills and the skin shows uneven temperatures with muscular tremors. Feeding and rumination are suspended. The coat is staring, the animal appears stupid and dull, the ears and base of horns are cold. There may be great uneasiness, kicking and pawing and cramping of the jaws. The feces become softer and covered with mucous and blood. The urine frequently contains blood, hence the name "red water." Before death there is a bloody discharge from nose, mouth, rectum and vagina. The symptoms in horses are very similar to those seen in spasmodic colic. Sheep usually die suddenly with an acute form.

The carcass of an animal which has died from anthrax soon becomes bloated. Small quantities of blood stained fluid is oozing from the mouth, nose and anus. On post mortem examination which should be made only in exceptional cases and by a person skilled in the diseases of animals, the spleen is enlarged and is unusually soft and blackish in color. The blood is black and tarry and not compactly coagulated. More or less blood stained gelatinous fluid is present in the chest (thoracic) cavity and the abdomen. There may be blood spots under the skin and on the mucous membranes, and frequently there are larger doughy swellings on the surface of the body, which are known as malignant pustule or local anthrax.

As regards treatment there is no known successful remedy. Preventative measures are specially useful. Keep animals from infected pastures and premises each year until safely vaccinated. When an animal dies suddenly and under suspicious circumstances in a

district where anthrax exists, a qualified veterinarian should investigate the case. If the disease proves to be anthrax he should notify the State Veterinarian at Harrisburg. An investigation will be made and if the diagnosis is verified vaccine will be sent immediately (free of charge) to be used on the exposed animals. Extreme care should be exercised in hauling or dragging the carcasses from the location at which it died. The skin should not be removed for the reason that the spores multiply rapidly in the presence of the oxygen of the air.

Persons are often infected with this disease through wounds or sores on the hands when handling hides from anthrax cases. Such hides are dangerous even after having passed through the process of tanning for leather.

The blood, feces and urine from an animal afflicted with anthrax are especially dangerous and should be most carefully disinfected.

HEMORRHAGIC SEPTICEMIA OF CATTLE

This disease is found in certain localities in Pennsylvania. It occurs principally in the mountinous regions of the State. In many of its characteristics it resembles anthrax. It occurs most often during the summer and early fall in cattle that are running at pasture.

The cause of the disease is the bipolar bacillus which was identified for the first time in Pennsylvania during the past summer by the laboratory of the State Livestock Sanitary Board. The disease has been recognized by this Board for the past twenty years.

The symptoms are so much like those seen in anthrax that it is not possible at the present to identify either disease without the assistance of a laboratory examination. The spleen is not enlarged in hemorrhagic septicemia, neither is there a marked lesion in very acute cases of anthrax.

Treatment is usually hopeless in cases of hemorrhagic septicemia. The State Livestock Sanitary Board hopes to be able in the future to provide a vaccination to prevent the disease. Such treatment has proven efficacious in preventing heavy losses in the buffaloes at the National Park.

The same careful precautions should be exercised in handling the carcasses of animals that have died from hemorrhagic septicemia as are applicable for anthrax. The danger of human beings becoming

infected from skinning and conducting autopsies on animals dead from hemorrhagic septicemia are not great yet infection is spread in such ways and becomes a source of great danger to susceptible animals.

When the disease occurs in a certain pasture, the healthy cattle should be moved at once to another locality.

BLACKLEG

Blackleg, symtomatic anthrax, blackquarter or quarter-ill, is a very fatal disease to young cattle and has been prevalent in certain sections of this State for years.

Sucking calves under six months of age are rarely affected. The disease usually affects animals between six months and two years of age. Man is immune to this disease as are also most all domesticated animals, except sheep and goats.

Blackleg like anthrax is a disease of certain localities where the soil becomes infested. The disease is usually contracted through a wound such as is caused by barbed wire, snags, brier, etc.

The bacillus causing blackleg can produce spores which are difficult to destroy. Even after several years drying and exposure to weather the germs are capable of producing the disease. The symptoms shown may be general or local, but is usually the latter, and consists of a tumorlike swelling under the skin a few hours after the animal is first noted to be sick. These swellings are usually located on the thighs which gives rise to the various names given this disease. The swellings may, however, appear on the neck, shoulder, breast and other parts of the body. If the hand is passed over the swelling a peculiar crackling sound is heard. This is due to a collection of gasses formed by the germs as they multiply. These swellings should not be cut open as the blood contains many of the germs which cause the disease and is likely to spread the infection. In addition to the local manifestation there is elevation of temperature. The latter may rise to 106° F. or even higher. There is loss of appetite, rumination ceases and evidence of general dullness is shown. Following several days illness the animal usually succumbs. Before death there may be occasional attacks of convulsions, increased weakness and difficult breathing.

Preventative rather than curative measures must be depended upon to control this disease. The State Livestock Sanitary Board has for a number of years provided an annual spring vaccination against this

disease. These vaccinations are usually made in March or early April before the young cattle are turned out to pasture. The Board advertises in the leading newspapers in the localities where blackleg is known to exist the fact that cattle on premises where blackleg has previously existed will be vaccinated free of cost to owner. Such assistance is offered on condition that the owner will communicate with the State Veterinarian before the date set in the advertisement advising as to the number of young cattle on the premises.

TEXAS FEVER

Southern cattle fever, frequently called Texas fever, is a disease not usually found in the United States north of the Southern cattle fever line. It is, therefore, of less importance to Pennsylvania farmers than some other infectious diseases.

The disease does not occur in the native Southern cattle which have been exposed since birth to infection. Only such cattle become infected as have not previously been exposed to ticks. Northern cattle are affected when taken into tick infested districts, or are exposed to cattle ticks in cars, yards, pens, etc., which have held Southern cattle shipped north for immediate slaughter.

The carrier of the disease is the Southern cattle tick (Margaropus annulatus) which is a parasite found on Southern cattle on pastures or premises occupied by southern cattle. The ticks do not pass from one animal to another but the young ticks after being hatched attach themselves to the skin of cattle. In case the animal is one which has not previously been exposed to ticks, and is immune, the disease will begin to show itself in from a week to ten days depending upon the season. In case the animal happens to be mature the symptoms are well marked and the disease as a rule terminates fatally. In calves and younger cattle, however, the disease may run milder course and the percentages of recoveries is greater. After an animal passes successfully through an attack of Texas fever it is immune from subsequent attacks even though it is afterwards extensively exposed to ticks.

The symptoms are a marked rise in temperature to 106° or 107° F. or even higher. The increase temperature is somewhat of an index to the severity of the attack—the higher the temperature the more acute the attack and fatal the end. On the other hand a temperature of say 104° F. indicates a milder and more prolonged attack. The afflicted animals are usually constipated; the urine appears normal until near the end when it becomes red due to blood stain from the red blood corpuscles (Hemoglobin). The animal becomes stupid—may lie down a great deal of the time. Some cases of delirium have been observed.

The course of the disease varies from a few to several days or longer depending upon the age, size and condition of animal; also on the severity of the attack as well as whether in hot season or late fall. Cool weather checks the hatching and activity of the ticks. Frost destroys them completely.

On post mortem examination the most noticeable changes observed of the internal organs is in the spleen (milt). It is much larger than in a healthy animal—may weigh five times the normal weight. When cut into it shows a blackish color. The liver is likewise much larger and instead of being brownish in color is quite yellow in appearance. When cut into the yellow appearance is even more marked. The gall bladder is invariably extended with bile in which is suspended great quantities of yellow flakes. Normally the bile contains no flakes or solid particles. Examination of the bladder shows the urine to be changed to a deep red resembling wine or even darker. The kidneys show a congested condition.

The percentage of deaths vary. In the hot season fatalities in mature cattle may run as high as 80 to 90 per cent. The disease can be prevented by the observance of the quarantine restrictions adopted by the Bureau of Animal Industry of the United States Department of Agriculture, and also by complying with the Pennsylvania regulations in reference to receiving and handling Southern cattle during the quarantine season which is from February 1st to October 31 of each year.

Treatment of individual cases is not practical in Pennsylvania. Animals infested with ticks should be washed with a five per cent. solution of creolin, and pens, yards, stables, cars, etc., occupied by them should be carefully disinfected before susceptible cattle are placed in them. Pastures may not be safe for ninety days or till frosty weather occurs.

RABIES

Rabies is a communicable disease affecting all warm-blooded animals, including man, but it most frequently affects members of the canine race. It is one of the oldest and first described of the infectious diseases; it having been recognized and written about several centuries prior to the Christan era.

The contagion of rabies has never been isolated, but it is known that it exists in nerve tissue, saliva and, some authorities claim, milk of affected animals. Next to dogs, cattle are most frequently affected with rabies. This no doubt, is due to the fact that cattle in the barn yard and pasture are more accessible to a rabid dog than are other warm blooded animals. Rabies does not arise spontaneously; rabies infection must be introduced into an animals's system before it can develop rabies. This material is usually introduced by the bite of a rabid dog.

The time that will elapse from the time the infection is introduced into a cow's system until the animal exhibits symptoms of rabies depends upon:

(a) Site of the bite (nearer to the brain the shorter the time will be, as the infection is carried along a nerve to the spinal column and then to the brain before symptoms develop).

(b) Females show symptoms in a shorter time than males.

(c) Young animals develop the disease more rapidly than mature animals.

(d) The severity of the wound (symptoms are not usually long in developing if the wound reaches a large nerve).

(e) A highly excitable animal naturally develops symptoms of rabies in a shorter time than a dull or sluggish animal.

In cattle, rabies usually develops in from fourteen to eighty days though it may develop within one hundred days; there being no authentic case of rabies on record where the disease developed in cattle subsequent to one hundred days following the bite of a rabid animal.

Frequently the first symptoms presented by cattle that have been exposed to infection with rabies is a loss of appetite, stopping of the secretion of milk, restlessness, fear and a general change in the disposition. The disease runs a more prolonged course in cattle than in the dog and the first symptoms are followed in a day or two by increased restlessness, loud and peculiar bellowing, attempts to butt anything within reach, particularly other animals. This fury may abate and the animal become rather dull, moves with difficulty, loses flesh rapidly, becomes paralyzed in one or both hind quarters and finally lies as if in a stupor, dying in about a week from the time the first symptoms are noted.

In Pennsylvania the State Livestock Sanitary Board is charged with the control of rabies and cases brought to its attention will be investigated free of cost to the owner. Indemnity for cattle lost on account of rabies may be collected from the County Commissioners who are required by law to pay all just claims from the fund provided by the taxation of dogs.

When an animal dies supposed to be affected with rabies, and the diagnosis has not been established by a competent veterinarian, the head of the suspected animal should be shipped to the Laboratory of the State Livestock Sanitary Board at 39th Street and Woodland Avenue, Philadelphia. The specimen should be wrapped in oil-cloth, packed in ice in a water tight container and forwarded by express plainly marked with the name and address of the sender. A complete report will be given to the shipper of the specimen free of cost, though no compensation can be allowed for gathering and shipping the material.

The contagion of rabies is destroyed in four or five days by drying. Sunlight destroys it in about forty hours. However, any premises that have been occupied by an animal affected with rabies should be sprayed with a four per cent. formalin solution and it should be allowed to remain on or about it for twenty-four hours. The place should then be scrubbed with soap and water to which ammonia has been added.

ACTINOMYCOSIS

Actinomycosis, or lumpy jaw, is a disease that affects cattle, horses and man. It has been produced experimentally in most all of these animals. It is of an infectious character, but spreads very slowly, because the disease is contracted only by inoculation, i. e., the fungus that causes actinomycosis must enter directly into the tissue that becomes affected.

The fungus is lodged upon plants, grain, etc., and when these materials are eaten the fungus has an opportunity to enter cuts, etc., in the gums from which lesions of the jaw develop. The skin of the tongue may be penetrated and the condition known as "wooden tongue" may result. It may be inhaled and lesions develop in the pharyangeal region or lungs. Infection is sometimes carried to the udder, stomach, intestines and liver where tumor-like growths develop.

The cases of actinomycosis most frequently brought to the attention of the State Livestock Sanitary Board are those where pronounced lesions are found on the head and neck of cattle and, as the common name "lumpy jaw" for this disease would imply, the vast majority of the cases are found on the lower jaw.

A slight thickening of one of the wings of the lower jaw of a cow is sometimes noted. This thickening increases, is hard and not very sensitive at first, but as it increases in size and becomes more painful. The swelling is rounded and one or more soft spots can be found. It is noticed that the animal is not eating well, does not chew on the side that is swollen, the soft spots break down, discharging a light creamy pus, the animal falls off in condition and it is not long before the character of the discharge changes, becoming very much soiled with blood, takes on a greenish color and becomes rather offensive. Direct channels can then usually be discovered leading from the outside of the lump directly into the thick part of the jaw-bone.

Lumps on the neck are usually given attention more promptly than would be a slight swelling of the jaw. These lumps are very often brought to the attention of the attending veterinarian and can usually be removed and if the animal is given proper medicine the condition is not likely to return or spread.

Hard knots in the udder must be regarded as suspicious, especially if other parts of the animal are affected with actinomycosis because next to jaw lesions, cases where the udder is affected are most common.

Actinomycosis of the pharyangeal region, lungs, stomach, intestines and lives is seldom diagnosed exepct at post mortem unless external lesions of actinomycosis are present and general disturbances would lead one to suspect that the liver, lungs or other organs are also affected with actinomycosis.

As actinomycosis is an infectious disease it comes under the jurisdiction of the State Livestock Sanitary Board. It is not of a highly infectious nature, its control is not difficult as the disease is not likely to spread in a herd. The affected animal should be treated in the early stages. Statistics show that about seventy-five per cent. of the animals poorly treated for actinomycosis recover.

An animal that has upon its body a discharging lesion of actinomycosis should not be allowed to pasture with other stock nor should it be allowed in a pasture that will subsequently be used by other stock. The animal should be fed and watered from a pail that will be used by no other animal, and milk produced by an animal afflicted with actinomycosis of the udder or advanced cases should not be used unless it is pasteurized by heating at a temperature of 149° F. for twenty minutes or sterlized by boiling. The manure, bedding, etc., from the stall of an animal affected with actinomycosis should be burned or deeply buried and when the animal has recovered or been removed the stall that it occupied should be scraped and the material accumulated burned or buried. The stall should then be scrubbed with a strong soda solution and sprayed with a three per cent. formalin solution.

CORN STALK DISEASE

Corn stalk disease has not been recognized in Pennsylvania. It occurs principally west of the Allegheny Mountains in sections where the corn is gathered and the stalks allowed to stand.

It is an acute fatal disease of cattle. The symptoms run a short course. Death usually occurs in a few hours and before it is known that the animal is sick. Where cattle are turned into a field of corn stalks the disease may occur in from a week to ten days and the first indication of anything wrong may be the discovery of several dead animals. The disease is not well understood and may, in many cases, have been confused with such diseases as anthrax, blackleg, hemorrhagic septicemia, etc. An investigation should always be made where animals have died from mysterious or unusual conditions.

CONTAGIOUS PLEURO-PNEUMONIA

Contagious pleuro-pneumonia or lung plague in cattle was introduced into America several different times. The first case in this country, according to history, was discovered in a cow sold in Brooklyn in 1943. The United States was one of the last countries to become affected with this disease, and with the exception of Holland, was the first to exterminate it. At one time the disease was prevalent as far west as Chicago and caused extensive losses to the cattle industry. The last case of this dreaded disease was destroyed in New Jersey in 1892. The older stockmen remember well the ravages to the cattle business caused by the lung plague. The work of exterminating it from the United States was one of the greatest victories ever accomplished by the veterinary profession.

It is doubtful whether this country will ever be called upon again to combat this disease, yet it is prevalent in some foreign countries and not beyond a possibility that it might occur. It is not probable that it will make any marked headway in a civilized country. It was stamped out in Great Britain in 1898. There has not been a case reported in Pennsylvania since 1889.

TUBERCULOSIS

From a feeder's standpoint tuberculosis is not an important disease. It is found occasionally even in Western steers. When calves have been raised on refuse from a creamery the disease is common. Infection in such cases is probably carried in skim milk. Hogs are frequently infected in the same way.

It is seldom advisable to test cattle with tuberculin when they are to be used only as feeders. They are soon sent to slaughter and advanced cases can be discovered by the Meat Hygiene service. Calves that are to be raised for beef or dairy purposes and hogs should not be fed creamery skim milk or separator slop unless it has previously been pasteurized. Such milk may be fed safely if heated to 178° F. In some places creameries, butter factories, etc., are required by law to pasteurize all such refuse as is returned to the farm for feeding purposes. The results are good and it is believed to be a just law. If this is not done farmers should cook it before it is fed to calves or hogs. If the owner has a tuberculosis herd himself the same precaution should be taken. At the farm belonging to the State Livestock Sanitary Board hogs and calves have been fed all the milk from about forty head of tuberculosis cows for several years and in no case has infection been carried to them. The milk is pasteurized by turning live steam into it and heating it to about 180° F. This plan of pasteurization is cheap and efficacious.

CHAPTER XXI

MISCELLANEOUS

THE CATTLE SUPPLY

In 1910 the value of the cattle of Pennsylvania was $47,202,000, and the State stood eleventh in the list. Pennsylvania's cattle numbered 1,585,570, of which 933,000 were dairy cows, 235,542 calves and 416,973 other cattle—the calves and other cattle including the beef industry. The census shows some remarkable facts in regard to the beef cattle industry of the country as a whole. In the decade 1900-1910 the total number of beef cattle decreased 16.3 per cent. while the population increased 21 per cent. Is it any wonder that cattle sell higher than they did when the ration of cattle to population was greater? It may be doubted whether this cattle shortage and the high prices which accompany it will stimulate production at once to such an extent as to bring about a higher ratio of cattle to population. High prices are now causing the slaughter of cows, heifers and calves—the source of future supplies—to such an extent as to prevent a rapid growth in the country's herds. So that while ultimately numbers of cattle will increase in response to financial inducements to the cattle raiser it is not likely that this increase will more than keep pace with the growth of the population during the present decade.

This is encuraging to the cattle-raiser. The day of cheap beef and low-priced cattle is gone forever in this country. Cheap beef went out with free grass, cheap land and cheap feed, and it will return no more unless some foreign source of supply can be found and the meat admitted to our markets free. The tables below present census figures as to the numbers and value of cattle in this country in 1910 and 1900:

1.—Comparative Summary of Cattle on Farms and Ranges of Continental United States: 1910 and 1900

Age and Sex Group.	1900 (June 1). Farmers Reporting. Number.	Farmers Reporting. Per cent. of all farms.	1900 (June 1). Number.	1900 (June 1). Value.	1900 (June 1). Average value.	Age and Sex Group.	1910 (April 15). Farmers Reporting. Number.	Farmers Reporting. Per cent. of all farms.	1910 (April 15). Number.	1910 (April 15). Value.	1910 (April 15). Average value.
Total,	5,265,772	83.1	61,225,791	$1,484,890,000	.....	Total,	4,730,480	82.4	67,719,410	$1,475,205,000	.....
Dairy cows,*	5,127,635	80.9	20,580,845	794,612,000	34.24	Dairy cows (2 years and over),	4,513,895	78.7	17,135,633	508,617,000	29.68
Other cows,†	1,440,383	22.7	11,788,473	263,123,000	22.32	Other cows (2 years and over),	979,656	17.1	11,559,194	271,203,000	23.47
Heifers born in 1909,	2,372,305	37.4	7,253,450	102,533,000	14.14	Heifers (1 and under 2 years),	.....	.....	7,174,483	121,528,000	16.94
Calves born after Jan 1, 1910,	2,647,484	41.8	7,757,935	51,600,000	6.65	Calves (under 1 year),	.....	.....	15,315,582	137,290,000	8.96
Total, steers and bulls,	.....	.....	13,845,088	363,021,000	26.22	Total, steers and bulls,	.....	.....	16,534,518	436,467,000	26.40
Steers and bulls born in 1909,	1,344,727	21.2	5,409,711	90,845,000	16.79	Steers (1 and under 2 years),	.....	.....	6,963,113	130,352,000	18.75
Steers and bulls born before Jan. 1, 1909.	857,564	13.5	7,447,562	251,490,000	33.77	Steers (2 and under 3 years),	.....	.....	5,193,006	151,387,000	29.15
						Steers (3 years and over),	.....	.....	3,073,267	109,367,000	35.59
Not specified,	5,442	0.1	987,815	20,686,000	20.94	Bulls (1 year and over),	.....	.....	1,315,132	45,362,000	34.49

*Cows and heifers kept for milk, born before Jan. 1, 1909.
†Cows and heifers not kept for milk, born before Jan. 1, 1909.

Fig. 37. PURE-BRED HEREFORDS—THE GET OF ONE SIRE.

Note the uniformity of type in these females, all the get of one sire. They are in show condition and illustrate the advantages of using a pure-bred bull, in uniformity, quality and flesh.

Fig. 38. A PURE-BRED HEREFORD COW IN SHOW CONDITION.

Note the "breadth of beam" and levelness of back where the high-priced cuts of beef are located

2.—Number and Value of Cattle on Farms and Ranges of Continental United States, by States: April 15, 1910

State and Division.	Value of all cattle.	Number of Cattle.			
		Total.	Dairy cows.	Calves.	All other.
Continental United States,	$1,484,890,000	61,225,791	20,580,845	7,757,935	32,887,011
New England Division,	42,233,000	1,336,305	811,518	168,010	326,777
Maine,	7,784,000	256,543	156,819	71,901	67,803
New Hampshire,	5,240,000	167,831	101,278	18,603	47,950
Vermont,	11,829,000	430,314	265,483	67,573	97,258
Massachusetts,	9,346,000	252,357	171,893	26,571	54,893
Rhode Island,	1,308,000	34,133	23,316	3,772	7,045
Connecticut,	6,725,000	195,147	122,729	20,590	51,828
Middle Atlantic Division,	138,508,000	4,221,875	2,595,900	761,579	932,356
New York,	83,016,000	2,432,593	1,508,672	438,124	474,797
New Jersey,	8,381,000	222,712	154,233	27,893	40,586
Pennsylvania,	47,202,000	1,585,570	933,055	295,542	416,973
East North Central Division,	271,759,000	9,813,548	4,825,912	1,449,049	3,538,587
Ohio,	51,370,000	1,836,403	904,603	255,537	676,263
Indiana,	39,110,000	1,363,016	633,591	184,153	545,272
Illinois,	73,378,000	2,438,146	1,049,044	323,820	1,065,282
Michigan,	40,500,000	1,497,823	767,083	236,050	494,690
Wisconsin,	67,400,000	2,678,160	1,471,591	449,489	757,080
West North Central Division,	449,218,000	17,655,000	5,324,374	2,319,431	10,011,285
Minnesota,	50,346,000	2,354,724	1,084,399	373,210	897,115
Iowa,	118,991,000	4,468,423	1,404,419	567,991	2,496,012
Missouri,	72,732,000	2,556,420	854,695	295,887	1,405,838
North Dakota,	17,727,000	745,181	261,917	130,483	352,781
South Dakota,	36,180,000	1,532,752	369,465	205,345	957,941
Nebraska,	73,049,000	2,931,255	613,707	324,817	1,992,731
Kansas,	80,184,000	3,066,337	735,772	381,698	1,948,867
South Atlantic Division,	89,362,000	4,829,613	1,867,365	574,288	2,447,960
Delaware,	1,648,000	54,986	35,708	7,153	12,125
Maryland,	7,870,000	287,751	166,859	39,064	81,828
District of Columbia,	75,000	964	842	49	73
Virginia,	21,103,000	808,185	355,980	83,826	418,379
West Virginia,	15,776,000	616,557	238,020	59,170	319,367
North Carolina,	12,537,000	700,208	308,608	88,985	302,615
South Carolina,	7,076,000	388,865	180,500	48,221	100,084
Georgia,	14,028,000	1,077,776	404,980	253,660	519,136
Florida,	9,248,000	844,312	115,808	94,160	634,353
East South Central Division,	75,264,000	3,936,878	1,625,872	481,685	1,829,321
Kentucky,	25,916,000	999,553	409,463	102,412	487,673
Tennessee,	20,655,000	994,941	396,338	114,019	484,584
Alabama,	13,462,000	931,986	301,377	115,452	425,157
Mississippi,	15,231,000	1,010,398	428,688	149,803	431,907
West South Central Division,	197,122,000	10,411,541	2,219,466	1,244,687	6,947,388
Arkansas,	15,444,000	1,027,639	425,320	100,134	432,576
South Atlantic Division,	89,362,000	4,829,613	1,867,365	574,288	2,447,960
Louisiana,	11,593,000	803,942	278,860	120,295	404,787
Oklahoma,	40,954,000	1,859,058	504,073	245,595	1,109,390
Texas,	129,131,000	6,721,502	1,011,204	709,663	5,000,635

2.—Number and Value of Cattle on Farms and Ranges of Continental United States, by States: April 15, 1910.—Continued.

State and Division.	Value of all cattle.	Number of Cattle.			
		Total.	Dairy cows.	Calves.	All other.
Mountain Division,	145,520,000	6,023,710	517,663	430,496	5,075,551
Montana,	27,459,000	942,604	77,437	82,596	782,571
Idaho,	11,266,000	450,844	86,209	49,148	315,487
Wyoming,	22,696,000	767,379	32,697	45,986	688,696
Colorado,	30,970,000	1,126,365	149,251	85,085	891,029
New Mexico,	26,245,000	1,672,656	51,209	49,067	972,356
Arizona,	14,408,000	811,766	28,199	56,237	727,330
Utah,	8,923,000	411,195	75,619	32,986	302,590
Nevada,	9,552,000	440,901	17,042	28,291	395,468
Pacific Division,	75,814,000	2,989,231	822,715	288,730	1,777,786
	*†				
Washington,	12,179,000	401,587	185,984	57,127	158,476
Oregon,	17,548,000	724,548	172,402	76,181	475,965
California,	46,087,000	1,863,096	464,329	255,422	1,143,345

TO FAIR MANAGERS

Here is a suggestion to managers of agricultural fairs and to those who are influential with fair authorities. The fairs have been criticised severely because they fail to provide certain things or to exclude other things; but as a rule they try to give the public what it wants. If the people whose money makes the fair go will make known what they want fairs will be more useful. One thing that farmers should ask of their fairs is, that they endeavor to interest the rising generation in agriculture by offering prizes for crops and livestock grown or fitted by boys. Corn is easy for a boy to raise and easy to show. The boy who can raise good corn is likely to be the one who will become interested in livestock, and here is the suggestion. Provide exhibits of fat stock at fairs—steers, hogs, lambs at least. Fat cattle always interest the public, particularly butchers, hotel-keepers who patronize them, and farmers. It takes time to fit a steer and the announcement should be made a year ahead if possible. Some fairs in this State offer such prizes as this but they are won usually by dealers who go out and buy fat steers and show them. In such cases it might be well to stipulate that the animals are to be shown by the feeder only.

The following classifications will be found useful, one for an extensive show and one for a smaller show. The aged classes may be omitted with least injury to the show:

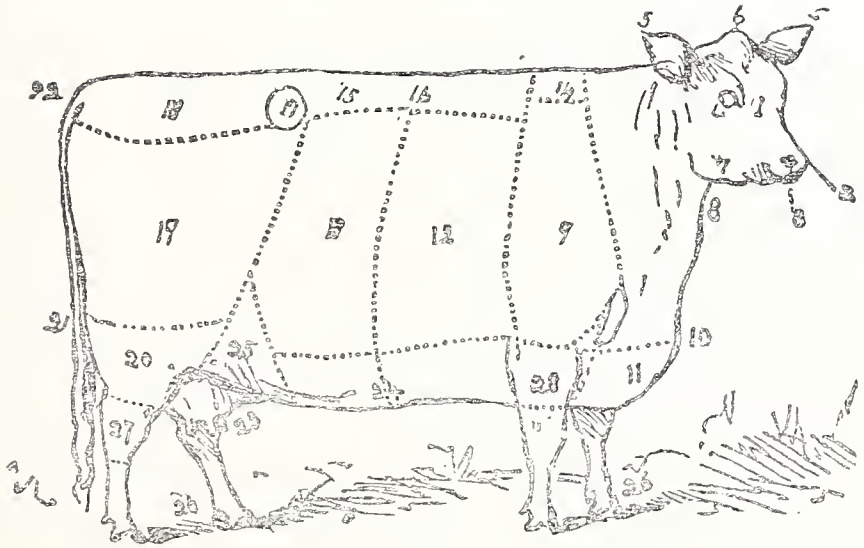


Fig. 38

1. Forehead and Face.
2. Muzzle.
3. Nostrils.
4. Eyes.
5. Ears.
6. Poll.
7. Jaws.
8. Throat.
9. Shoulders.
10. Chest.
11. Brisket.
12. Fore Ribs.
13. Back Ribs.
14. Crops.
15. Loins.
16. Back.
17. Hooks.
18. Rumps.
19. Hindquarters.
20. Thighs.
21. Twist.
22. Tail.
23. Scrotum (or udder).
24. Underline.
25. Flanks.
26. Legs or Bone.
27. Hocks.
28. Forearms.
29. Horns—not shown here.

HOW TO THROW A BULL

The best way is to cast the animal, and this may be quickly, easily and safely effected by the following method: Put a halter on take a sound, ordinary cart rope, make a loop at one end and pass it over the head and let it rest close around the neck, low down, like a collar; bring the rope to the near side, pass it over the back just behind the shoulders; bring it underneath the chest and pass it under and then above the rope, so as to make a loop around the chest; carry the rope back, pass it over loins, and bring it under neath the belly close to the flanks; make another loop as before and carry the rope straight behind the animal; tighten up the loops, one close to the elbows, the other close to the rear flanks.

All being ready, instruct the man who holds the halter shank to pull forward and at the same time the men who have hold of the loose end of the rope to pull straight backward, and down the animal goes, generally without a struggle. Keep the head down and the rope firm, and as a rule the animal lies quietly until such time as it is desired he should get up, when slacken the rope and up he gets, none the worse for the casting. The heaviest bull may be cast in this way, but of course no one would think of casting an in-calf cow or heifer, either in this or any other way.—Clement Stephenson, in Journal of Royal Agricultural Society of England.

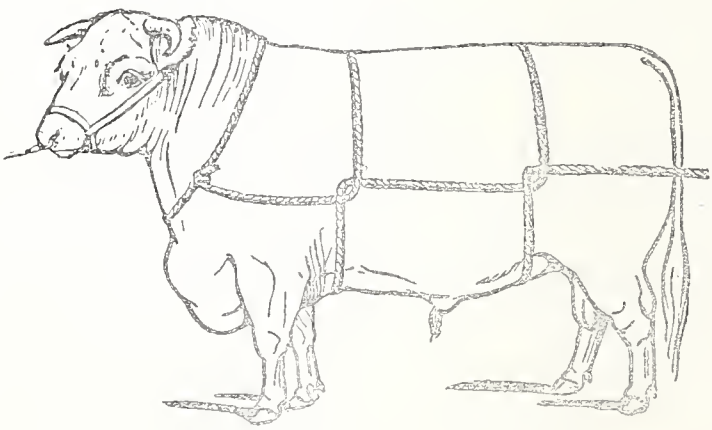


Fig. 39. ANIMAL ROPED FOR THROWING.

Shorthorn and Polled Durham, Angus, Hereford, Galloway classes, pure-bred or grade as the cattle of the community indicate:

Steer two years and under 3 . . . .
Steer one year and under 2 . . . .
Steer calf under one year . . . .

Herd—Best herd consisting of three steers one of each age.
Get of sire—Two steers the get of one bull.

This is sufficient for any local fair and perhaps more than will be used by the majority. The following may be used:

Steer, any breed, grade or cross:
Steer two years and under 3 . . . .
Steer one year and under 2 . . . .
Steer calf under one year . . . .

The ages of the steers should date from September 1st, except perhaps in the calf class, which should date from January 1st. This is not because there is any merit in that date but because most shows specify it. An additional class for calves under six months old may help to interest the boys. A calf af that age is easy to fit, as it has or may have its dam's milk, and a prize won by a boy may start him on the way to interest in livestock and its improvement.

GESTATION TABLE

Below is a gestation table, showing the time when colts, calves, lambs, pigs and puppies may be expected, the date of service being known:

Time of service.	Mares 340 Days.	Cows 283 Days.	Ewes 130 Days.	Sows 112 Days.	Bitches 63 Days.
Jan. 1	Dec. 6	Oct. 10	May 30	Apr. 23	Mar. 4
" 6	" 11	" 15	June 4	" 27	" 9
" 11	" 16	" 20	" 9	May 2	" 14
" 16	" 21	" 25	" 14	" 7	" 19
" 21	" 26	" 30	" 19	" 12	" 24
" 26	" 31	Nov. 4	" 24	" 17	" 29
" 31	Jan. 5	" 9	" 29	" 22	Apr. 3
Feb. 5	" 10	" 14	July 4	" 27	" 8
" 10	" 15	" 19	" 9	June 1	" 13
" 15	" 20	" 24	" 14	" 6	" 18
" 20	" 25	" 29	" 19	" 11	" 23
" 25	" 30	Dec. 4	" 24	" 16	" 28
Mar. 2	Feb. 4	" 9	" 29	" 21	May 3
" 7	" 9	" 14	Aug. 3	" 26	" 8
" 12	" 14	" 19	" 8	July 1	" 13
" 17	" 19	" 24	" 13	" 6	" 18
" 22	" 24	" 29	" 18	" 11	" 23
" 27	Mar. 1	Jan. 3	" 23	" 16	" 28
Apr. 1	" 6	" 8	" 28	" 21	June 2
" 6	" 11	" 13	Sept. 2	" 26	" 7
" 11	" 16	" 18	" 7	" 31	" 12
" 16	" 21	" 23	" 12	Aug. 5	" 17
" 21	" 26	" 28	" 17	" 10	" 22
" 26	" 31	Feb. 2	" 22	" 15	" 27
May 1	Apr. 5	" 7	" 27	" 20	July 2
" 6	" 10	" 12	Oct. 2	" 25	" 7
" 11	" 15	" 17	" 7	" 30	" 12
" 16	" 20	" 22	" 12	Sept. 4	" 17
" 21	" 25	" 27	" 17	" 9	" 22
" 26	" 30	Mar. 4	" 22	" 14	" 27
" 31	May 5	" 9	" 27	" 19	Aug. 1
June 5	" 10	" 14	Nov. 1	" 24	" 6
" 10	" 15	" 19	" 6	" 25	" 11
" 15	" 20	" 24	" 11	Oct. 4	" 16
" 20	" 25	" 29	" 16	" 9	" 21
" 25	" 30	Apr. 3	" 21	" 14	" 26
" 30	June 4	" 8	" 26	" 19	" 31
July 5	" 9	" 13	Dec. 1	" 24	Sept. 5
" 10	" 14	" 18	" 6	Nov. 3	" 15
" 5	" 19	" 18	" 16	" 8	" 20
" 15	" 24	" 23	" 21	" 13	" 25
" 20	" 29	" 28	" 26	" 18	" 30
" 25	July 4	May 3	" 31	" 23	Oct. 5
" 30	" 9	" 8	Jan. 5	" 28	" 10
Aug. 4	" 14	" 13	" 10	Dec. 3	" 15
" 9	" 19	" 18	" 15	" 8	" 20
" 14	" 24	" 23	" 20	" 13	" 25
" 19	" 29	" 28	" 25	" 18	" 30
" 24	Aug. 3	June 2	" 30	" 23	Nov. 4
" 29	" 8	" 7	Feb. 4	" 28	" 9
Sept. 3	" 13	" 12	" 9	Jan. 2	" 14
" 8	" 18	" 17	" 14	" 7	" 19
" 13	" 23	" 22	" 19	" 12	" 24
" 18	" 28	" 27	" 24	" 17	" 29
" 23	Sept. 2	July 2	Mar. 1	" 22	Dec. 4
" 28	" 7	" 7	" 6	" 27	" 9
Oct. 3	" 12	" 12	" 11	Feb. 1	" 11
" 8	" 22	" 17	" 16	" 6	" 19
" 18	" 27	" 27	" 21	" 11	" 24
" 23	Oct. 2	Aug. 1	" 26	" 16	" 29
" 28	" 7	" 6	" 31	" 21	Jan. 3
Nov. 2	" 12	" 11	Apr. 5	" 26	" 8
" 7	" 17	" 16	" 10	Mar. 3	" 13
" 12	" 22	" 21	" 15	" 8	" 18
" 17	" 27	" 26	" 20	" 13	" 23
" 22	Nov. 1	" 31	" 25	" 18	" 28
" 27	" 6	Sept. 5	" 30	" 23	Feb. 2
Dec. 2	" 11	" 10	May 5	" 28	" 7
" 7	" 21	" 20	" 10	Apr. 2	" 12
" 17	" 26	" 25	" 15	" 7	" 17
" 22	Dec. 1	" 30	" 20	" 12	" 22
" 27	" 5	Oct. 5	" 25	" 17	" 27
" 31		" 9	" 29	" 21	Mar. 3